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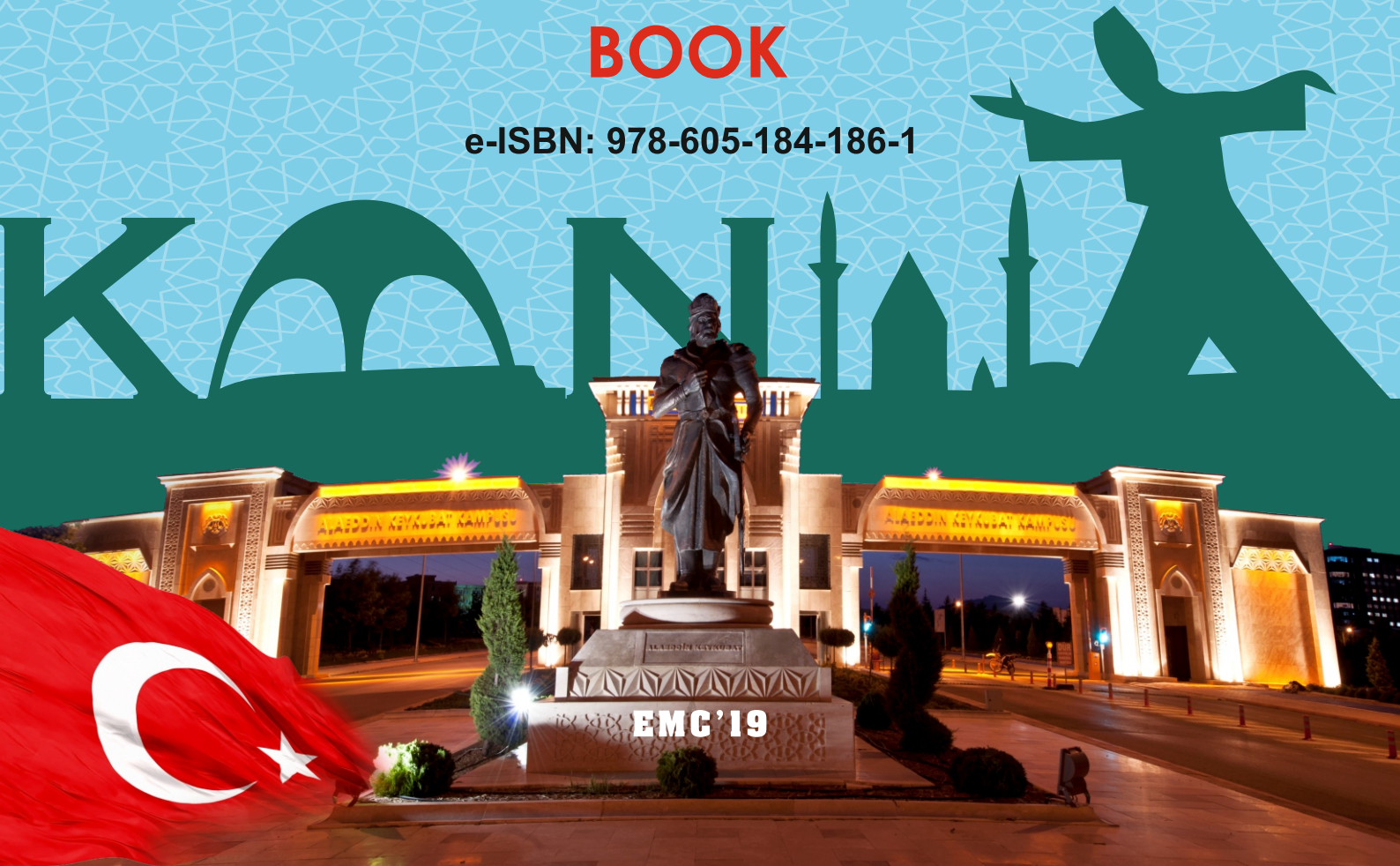

Book of Proceedings and Abstracts
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2ND INTERNATIONAL EURASIAN MYCOLOGY CONGRESS (EMC' 19)

2. ULUSLARARASI AVRASYA MİKOLOJİ KONGRESİ (EMC'19)

BOOK OF PROCEEDINGS AND ABSTRACTS

TAM METİN VE ÖZET KİTABI

September 04-06, 2019
Konya-Türkiye

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Wednesday, Thursday, Friday
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2. ULUSLARARASI AVRASYA MİKOLOJİ KONGRESİ
SONUÇ BİLDİRİSİ

2. Uluslararası Avrasya Mikoloji Kongresi 04 - 06 Eylül 2019 tarihleri arasında Konya Selçuk Üniversitesi Süleyman Demirel Kültür Merkezinde iki salonda 16 oturumda 67 sözlü bildiri ve üç oturumda 41 poster sunumu ile gerçekleştirilmiştir.

Kongrede yapılan "Mikoloji ve Geleceği" konulu özel oturumdaki görüşmeler sonucunda aşağıdaki konularda fikir birliğine varılmıştır.

1- Kongrenin 2021 tarihinde nerede yapılacağı hakkında gerçekleştirilen gizli oy açık sayım şeklinde oylama yapılmıştır. İki aday seçime katılmıştır. Seçime katılan 75 kişiden; 18 oyu Çanakkale, 57 oyu ise Van almıştır. 2021 de yapılacak "3. Uluslararası Avrasya Mikoloji Kongresi"nin Van da yapılması karar altına alınmıştır.

2- Mikoloji ve Geleceği konusunda görüşmeye açılan konular değerlendirilmiş ve aşağıdaki konularda fikir birliğine varılmıştır;

   a- Mikoloji kongresine katılımın artırılması için genç araştırıcılara ayrıcalık tanınmak suretiyle maddi olarak destek olunmasının gerektiği,

   b- Yine genç araştırıcıların kendilerindeki özgüvenin gelişmesi için danışman hocaların mümkün olduğu kadar kongre sunumlarına birlikte gelmesinin önemli fayda sağlayacağı,

   c- Mikoloji alanında çalışan genç araştırıcıların teşvik edilmesi konusunda fikir birliğine varılmış, ancak genç araştırıcıların eksikliklerinin uygun bir dil ile kendilerine belirtilmesinin bilimsel gelişmeleri için gerekli olduğu,

   d- Yine kongreye katılımın arttırılması için bir önceki kongreye katılanlara ve kurulacak olan bir derneğe üye olanlara da katılım ücretinde indirim yapılabileceği,

   e- Kongreye katılımın arttırılması için mikoloji ile ilgili farklı alanlarda çalışan tüm araştırıcılara ulaşmak için çalışma yapılması,

   konularında fikir birliğine varılmıştır.

3- Konya merkezli bir "Mikoloji Derneği"nin, aktif olarak çalışmalar yapılması konusunda birçok faaliyette bulunabileceği göz önüne alınarak kurulmasının önemli olduğu,

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4- Mikoloji alanında gelişmelerin daha ivmeli olması için üniversitelerde lisans eğitiminde Mikoloji dersinin zorunlu olarak okutulmasının, lisansüstü eğitimin gelişmesi için çok önemli bir husus olduğu belirtilmiş ve bu konuda yükseköğretim kuruluna ve üniversitelerin ilgili bölümlerine bir metin hazırlanarak kongre adına gönderilmesinin fayda sağlayacağı,

5- Ülkemizde Mikolojinin gelişmesi için, gerek kültür koleksiyonlarının gerekse biyoçeşitliliğin korunmasında ve mikolojik çalışmaların artırılmasında önemli bir basamak olarak Mikoloji Enstitüsü'nün kurulmasının önemli bir adım olacağı ve gereklilik olduğu,

6- TÜBİTAK'ta mikoloji ile ilgili proje değerlendirmelerinde sadece mikoloji ile ilgili alanda çalışan panelistlerin yer aldığı panellerin oluşturulmasının proje değerlendirmelerinin objektif olmasına katkı sağlayacağı konusunda fikir birliğine varılmış ve bu konuda ilgililerin bilgilendirilmesi konusunda çalışmalar yapılmasına,

7- Mikoloji alanında ülkemizde tek bilimsel dergi olan "Mantar Dergisi" nin çalışmalarla desteklenmesi,

konularında fikir birliğine varılmıştır.

Yukarıda belirtilen hususlar 2. Uluslararası Avrasya Mikoloji Kongresi'nin kapanış oturumunda sonuç bildirisi olarak okunmuştur.

Bu sonuç bildirisi iki oturum başkanı ve iki raportör tarafından tutulan raporlar ile "Mikoloji ve geleceği" konulu oturumda konuşulan konular göz önüne alınarak hazırlanmış ve imza ile kayıt altına alınmıştır.

06/09/2019

Dr.Sinan ALKAN Raportör	Dr. Sinan AKTAŞ Raportör	Dr. Faruk SELÇUK Oturum Başkanı	Dr. Gıyasettin KAŞIK Kongre ve Oturum Başkanı

İçindekiler

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ORAL PRESENTATIONS FULL TEXT

ANALYSIS OF DISTRIBUTION RATES OF SOME PUBLICATIONS THAT CONTAINS *ASPERGILLUS, PENICILLIUM, FUSARIUM, ALTERNARIA* AND *CLADOSPORIUM* FUNGAL GENERA ORIGINATED IN SOME COUNTRIES VIA WEB OF SCIENCE DATABASE (1.1.1900 - 25.7.2019)

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ABSTRACT

Among the microfungi such as *Aspergillus, Penicillium, Fusarium, Alternaria* and *Cladosporium* genera are common in nature, the rate of presence in nature may vary depending on their habitats. In this study, using the Clarivate Analytics *Web of Science* (SCI-Expanded, SSCI, AH&CI and ESCI) database, it was aimed to determine the country origin of the publications related to these genera. Also in our country (keyword: Turkey or Turkiye) relevant publications, citations and the other data are compared with some countries particularly close to Turkey.

The data was prepared using the Clarivate Analytics Web of Science Database. "*Aspergillus* or *Penicillium* or *Fusarium* or *Alternaria* or *Cladosporium*" were used as keywords and the number of publications that contain these keywords were used in that country was determined. Data were taken into consideration for all types of publications since 1900 for SCI-Expanded database, 1956 for SSCI, 1975 for AHCI and 2015 for ESCI databases.

Total number of publications obtained by using keywords: 136881. Total number of fulltext articles: 114101. For 136881 publications, 108704 publications addressing these countries were considered, with a ratio of 79.41 %. The oldest publication: 1906. In fact, it may be older, because WOS does not scan publications older than 1900. For example, in Google Scholar, the oldest publication for the word *Aspergillus* dates back to 1740. The earliest years were 1713 for *Penicillium*; 1820 for *Alternaria* and *Cladosporium* and 1817 for *Fusarium.* Turkish academics collaborate mostly with researchers from the USA, England and the Netherlands. The countries in which other countries publications jointly, USA, England, Germany and the Netherlands are in the foreground. There are 1840 publications with addressed Turkey (1606 fulltext articles) has contributed to publications 1.34 % (fulltext articles contribution rate of 1.41 %). Although these values are close to Iran, they are more than Greece. However impact value of Greece (22.91) is higher than in Turkey (14.54). In contrast, Turkey's h index value is 72, Greece is 69, Iran is 55 and Russia is 53. UK, Germany and the Netherlands are listed after the USA for the h index value. If we considering the number of total citations, the US is the first. England, Germany, Japan, France, the Netherlands, China and Spain were followed the USA. But considering the impact value, the ranking has been different. For example, number of publications in Japan are higher than the Netherlands, but the Netherlands has a higher impact value. In this field, publications originating from Turkey started late (1977), the number of publications (1840) and our contribution rate (1.34 %) were low. The increase in the number of publications depends on academicians as well as other factors. For example, unfortunately there is no culture collection center for microfungi in international standards in our country. The presence of such a center will increase the number of publications in this field, will contribute to the improve of new researchers in this field and will attract the attention of researchers from various countries in this field for our country.

Key words: *Aspergillus, Penicillium, Fusarium, Alternaria, Cladosporium,* Country, analysis**.**

Web Of Science Veritabanında *Aspergillus, Penicillium, Fusarium, Alternaria* Ve *Cladosporium* Gibi Yaygın Fungal Cinslerin Bazı Ülkeler Bazında Geçme Oranları Ve Dağılım Analizi (1.1.1900 - 25.7.2019).

ÖZ

Mikrofunguslar içinde *Aspergillus*, *Penicillium*, *Fusarium*, *Alternaria* ve *Cladosporium* gibi cinslerin daha yaygın olduğu görülmekle beraber, doğada bulunma oranları habitatlara bağlı olarak değişiklik gösterebilmektedir. Bu çalışmamızda, Clarivate Analytics *Web of Science* (SCI-Expanded, SSCI, AH&CI ve ESCI) veritabanı kullanılarak, bu cinslerle ilgili yayınların en çok hangi ülkelerden kaynaklandığını tespit etmek amaçlanmıştır. Ayrıca ülkemizde (anahtar kelime: Turkey or Turkiye) bu konuyla ilgili yayın, atıf ve diğer verilerin durumunun özellikle bize yakın bazı ülkelerle kıyaslanması da yapılmıştır.

Veriler, Clarivate Analytics Web of Science Veritabanından yararlanılarak hazırlanmıştır. Anahtar kelime olarak "*Aspergillus* or *Penicillium* or *Fusarium* or *Alternaria* or *Cladosporium*" kulanılmış ve o ülkedeki bu anahtar kelimelerin geçtiği yayın sayıları tespit edilmiştir. Veriler, SCI-Expanded veritabanı için 1900, SSCI için 1956, AHCI için 1975 ve ESCI için 2015 yıllarından itibaren olan tüm yayın tipleri dikkate alınmıştır.

Toplam yayın sayısı: 136881. Tam makale sayısı: 114101. 136881 yayın için bu ülkeler adresli 108704 yayın dikkate alınmıştır, oran: % 79.41. En eski yayın: 1906'da. Aslında daha eski de olabilir, çünkü WOS 1900'den daha eski yayınları taramıyor. Örneğin Google Akademik'de, *Aspergillus* kelimesi için en eski yayın 1740 yılına aitdir. En eski yıllar, *Penicillium* için 1713; *Alternaria* ve *Cladosporium* için 1820; *Fusarium* için ise 1817'dir. Türk akademisyenler bu alandaki yayınları yaparken en çok ABD, İngiltere ve Hollanda'lı araştırmacılar ile işbirliği yapıyorlar. Diğer ülkelerin ortak yayın yaptığı ülkeler içinde ABD, İngiltere, Almanya ve Hollanda ön plandadır. Türkiye 1840 yayınla (1606 tam makale) bu yayınlara % 1.34 oranında katkı yapmıştır (tam makale katkı oranı % 1.41). Bu değerler İran ile yakın olmasına rağmen Yunanistan'dan fazladır. Ancak Yunanistan'nın etki değeri (22.91) Türkiye (14.54)'den yüksektir. Buna karşılık Türkiye'nin h indeks değeri 72, Yunanistan'nın 69, İran'ın 55 ve Rusya'nın 53 olmuştur. h indeks değeri için ABD'den sonra İngiltere, Almanya ve Hollanda sıralanmıştır. Atıf sayısını dikkate aldığımızda, ABD açık ara öndedir. ABD'yi İngiltere, Almanya, Japonya, Fransa, Hollanda, Çin ve İspanya takip etmektedir. Ama etki değeri dikkate alındığında sıralama farklı olmuştur. Örneğin Japonya'nın toplam atıf sayısı Hollanda'dan fazladır ancak Hollanda'nın etki değeri daha yüksektir. Bu alanda ülkemiz kaynaklı yayınlar geç başlamış (1977), yayın sayımız (1840) ve katkı oranımız da düşük sayılabilecek (% 1.34) seviyededir. Yayın sayısının artması akamdemisyenlere bağlı olduğu gibi, başka faktörlere de bağlıdır. Örneğin ülkemizde uluslararası standartlarda mikrofunguslar için bir kültür koleksiyon merkezi maalesef yoktur. Böyle bir merkezin olması, hem bu alandaki yayın sayılarını arttıracak, hem bu alanda yeni araştırmacıların yetişmesine katkı yapacak ve hem de ülkemiz için bu alanda çeşitli ülke araştırmacılarının dikkatini çekecektir.

Anahtar kelimeler: *Aspergillus, Penicillium, Fusarium, Alternaria, Cladosporium,* ülke, analiz.

Introduction

There are 110,000-120,000 registered fungal species in the world but it is estimated that there are around 1.5 millions. According to the 2018 report published by Kew Royal Botanic Gardens (https://stateoftheworldsfungi.org/2018/reports/SOTWFungi_2018_Full_Report.pdf), the number of fungal species is around 144,000 (Ascomycota 90,000 species, Basidiomycota 50,000, Mucoromycota 760, Zoopagomycota 900, Chytridiomycota 980, Blastocladiomycota 220, Cryptomycota 30 and Microsporidia 1250). The frequency and proportion of fungi in soil, air, water, food and living things are not the same, some are more common. The taxonomic status of fungi varies, particularly in the upper categories (such as the phylum). In a declaration published in 2011 (Hawksworth et al., 2011), the fungal taxonomic system has changed considerably.

According to publications on microfungi, *Aspergillus, Penicillium, Fusarium, Alternaria* and *Cladosporium* genera are common in nature. However, their presence in nature varies depending to habitats. For example, the most common fungal genus is *Cladosporium* in air environment (Asan and Giray, 2019). Also *Fusarium* species may be more common on plants and soil. There are several reasons why the distributions are different.

Important databases such as *Web of Science* (including SCI-Expanded, SSCI, AH&CI and ESCI) (WOS), PubMed, SCOPUS are periodically announce the content of the scientific journals they include to their readers. The aim of this study is to determine the origin of the publications on the most common genera such as *Aspergillus, Penicillium, Fusarium, Alternaria* and *Cladosporium*. Thus, in our country (keyword: Turkey or Turkiye) study aimed to compare the situation with other countries on this issue. Although a few publications in the literature on this subject, Asan (2016), resulting in mycology journals covered by SCI-Expanded database (with Turkey address) has made an analysis. According to this study, Turkey, as of the date of August 5, 2015, 529 publications has contributed 1 % of world publications. Also Ergin (2007) provided valuable information on the subject. The main reason for the prefer Web of Science for analysis is the widespread use of publications in journals within the scope of this database for academic upgrades, especially in the fields of science, engineering and health in Turkey.

Materials and Methods

The data was prepared using the Clarivate Analytics Web of Science Database. In the database, *Aspergillus* or *Penicillium* or *Fusarium* or *Alternaria* or *Cladosporium* were used as keywords and the publications in which these keywords were found in that country were found. Data were taken into consideration for all types of publications since 1900 for SCI-Expanded database, 1956 for SSCI, 1975 for AHCI and 2015 for ESCI databases because of the oldest years of browsing of these databases. However, SCI-Expanded database is important because of provide to go back to 1900 and search for the fungal species mentioned in these databases. Also it was utilized Web of Science core collection such as Conference Proceedings Citation Index- Science (CPCI-S) (since 1990), Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH) (since 1990), Book Citation Index – Science (BKCI-S) (since 2005) and Book Citation Index – Social Sciences & Humanities (BKCI-SSH) (since 2005). All tips ofpublications were considered for analyses. The main reason for this is to reach more data by country. Since the number of publications for a country exceeds 10,000, the system does not allow citation analysis, however, it is rare, only restrictions such as fulltext article and year reduction have been imposed. USA, China, Japan, The Netherlands, Germany, India, France, England, Canada, Italy, Spain and Brazil were selected as the most widely published countries in this field after the keywords were entered. Russia, Iran and Greece are among the selected countries and they were chosen to compare the close to our country.

Results

Total number of publications obtained by using keywords: 136881. Total number of fulltext articles: 114101. For 136881 publications, 108704 publications addressing these countries were considered, with a ratio of 79.41 %. The oldest publication: 1906. In fact, it may be older, because WOS does not scan publications older than 1900. For example, in Google Scholar, the oldest publication for the word *Aspergillus* dates back to 1740. The earliest years were 1713 for *Penicillium*; 1820 for *Alternaria* and *Cladosporium* and 1817 for *Fusarium*. Turkish academics collaborate mostly with researchers from the USA, UK and the Netherlands. The countries in which other countries publications jointly, USA, UK, Germany and the Netherlands are in the foreground.

Table 1. Years of first publication for selected countries and other data.

Country	First year of keywords in Web of Science database	Number of publications (number of fulltext articles in parentheses)	Average number of Citations received by each publication	h index	Contribution rate (%) (fulltext article contribution in parentheses)	Situation of next years
Italy	1906	4676 (3905)	24.15	123	3.42 (3.42)	After 1 publication in 1943, until 1972, there are no any publications containing selected keywords

Table 1. continue

USA	1907	24419 (19528)	46.09	284	17.84 (17.11)	there are no any publications containing selected keywords between the yaers of 1945-1971.
England	1927	6685 (5553)	35.12	177	4.88 (4.87)	there are no any publications containing selected keywords between the years of 1945-1955.
Canada	1929	5020 (4120)	27.99	143	3.67 (3.61)	there are no any publications containing selected keywords between the years of 1930-1941 and 1943-1971.
The Netherlands	1933	4166 (3521)	39.12	158	3.04 (3.09)	there are no any publications containing selected keywords to 1958.
Germany	1935	7304 (6129)	29.44	161	5.34 (5.37)	there are no any publications containing selected keywords to 1972.
Japan	1937	8676 (7637)	21.62	135	6.34 (6.69)	there are no any publications containing selected keywords to 1970.
India	1970	11340 (9973)	14.87	121	8.28 (8.74)	-
China	1971	13060 (11842)	16.82	110	9.54 (10.38)	there are no any publications containing selected keywords to 1979.
France	1972	5727 (4892)	31.68	154	4.18 (4.29)	-
Spain	1973	5825 (4989)	25.18	130	4.25 (4.37)	-
Greece	1973	1145 (938)	22.91	69	0.84 (0.82)	-
Brazil	1973	5679 (5173)	15.55	97	4.15 (4.53)	
Iran	1976	1826 (1538)	10.59	55	1.33 (1.35)	-
Turkey	1977	1840 (1606).	14.54	72	1.34 (1.41)	there are no any publications containing selected keywords between the years of 1978-1985.
Russian Federation	1991	1316 (1173)	9.93	52	0.96 (1.03)	-

Table 2. Other data for selected countries.

Country	Number of total citations	Number of citations excluding self-citations	Self-citation rate (%)	Citing articles	Average citations per Year	Top 5 periodicals for each contry
Italy	112945	101900	9.78	72148	1590.77	Acta Hort, Int J Food Microbiol, Plant Dis, J Agr Food Chem, Eur J Plant Pathol.
USA	647995	584867	9.74	327601	3871.60	Phytopathol, Plant Dis, Appl Env Microbiol, Fungal Gen Biol, Antimicrobial Agents Chemoter.
England	234780	214572	8.61	140407	2551.96	J Gen Microbiol, Plant Pathol, Mycol Res, Trans Brit Mycol Soc, Ann Appl Biol, Fungal Gen Biol.
Canada	139497	128505	7.88	95410	1885.59	Can J Plant Sci, Can J Plant Pathol-Revue Can De Phytopathol, Phytopathol, Can J Plant Pathol, Can J Microbiol.
The Netherlands	162977	141441	13.21	86519	1873.30	Fungal Gen Biol, Appl Env Microbiol, Stud In Mycol, Appl Microbiol Biotechnol, J Clin Microbiol.
Germany	215061	190569	11.39	124065	4480.44	Mycoses, Appl Microbiol Biotechnol, Plos One, Molecular Microbiol, Fungal Gen Biol.
Japan	187572	161775	13.75	113756	2436.00	Biosci Biotechnol Biochem, Agr Biol Chem, J Antibiotics, J Biosci Bioeng, Appl Microbiol Biotechnol.
India	148340	131559	11.31	92857	2966.80	Curr Sci, World J Microbiol Biotechnol, Biores Technol, Ind J Agr Sci, Appl Biochem Biotechnol.
China	162635	140851	13.39	94166	4073.13	Plant Dis, Plos One, Appl Microbiol Biotechnol, Sci Rep, Biores Technol.
France	181409	165627	8.70	114270	3943.67	J Mycol Med, Med Mycol, Mycoses, PLos One, Appl Env Microbiol.
Spain	146682	125983	14.11	85445	3120.89	Int J Food Microbiol, Antimicrobial Agents Chemoter, J Agr Food Chem, Fungal Gen Biol, Acta Hort.

Table 2. continue

Greece	26235	23471	10.54	19460	570.33	Mycoses, Antimicrobial Agents Chemoter, Plant Dis, Fungal Gen Biol, Med Mycol.
Brazil	88316	75387	14.64	57385	2053.86	Braz J Microbiol, Appl Biochem Biotechnol, Rev Microbiol , Pesq Agr Brasil, Braz Arch Biol Technol
Iran	19331	17550	9.21	15616	439.34	Jundishapur J Microbiol, Acta Hort, Mycoses, J De Mycol Med, Iran J Publ Health.
Turkey	26748	24966	6.66	21332	722.92	Fren Env Bull, Mikrobiyol Bult, Acta Hort, Mycoses, Mycopathol.
Russian Federation	13064	11847	9.32	10410	483.85	Appl Biochem Microbiol, Microbiol, Mikol I Fitopat, Biochem Moscow, Chem Nat Comp.

Turkey: Totaly 1840 publications. Top 5 universities that the most publications in this field: Hacettepe (143 publications, % 7.77), Ege (142 publications, % 7.72), Istanbul (116 publications, % 6.30), Ankara (104 publications, % 5.65), Ataturk (98 publications, % 5.32). Top 5 journals that the most publications in this field: Fres Env Bulletin (54 publications, % 2.94), Mikrobiyol Bult (37 publications, % 2.01), Acta Hort (36 publications, % 1.96), Mycoses (29 publications, % 1.56) and Mycopathol (25 publications, % 1.36),

Discussion

According to the Web of Science database, the oldest publications on the subject were made in Italy in 1906 and in the USA in 1907 (Table 1). However, in many countries, especially during the Second World War, it is seen that there is no more publications. For example, there are no publications in Italy between the years of 1907-1942 and 1944-1971. Although the first publication in the England in 1927, there is no publication between the years of 1945-1955 and in the USA between 1945-1971. In Germany, although the first publication was in 1935, there was no publication between the years of 1936-1971. Also the first publication in the Netherlands was in 1933, there were no publications between the years of 1934-1957. The first publication from Japan was made in 1937, but there was no publication between 1938-1969. In China, however, there is a different situation, the first publication in 1971, but no publication between the years of 1972-1978. Although the first publication in Canada was in 1929, there were no publications between the years of 1930-1941 and 1943-1971. In other selected countries, the first publications were after the second world war; for example, first published in 1970 in India, 1972 in France, Brazil, Spain and 1973 in Greece, 1976 in Iran, 1977 in Turkey and 1991 in Russian Federation. There are no publications originating from Turkey between the years of 1978-1984. In fact, I know Mehmet Öner's article entitled «Soil microfungi of Turkey. Mycopathol et Mycol Appl. 42 (1-2): 81-87, 1970». But there is no volume 42 of the mentioned journal in the WOS Database, I found it in Journal official website. Also there is an article published in 1974 by M. Öner but there is no any **Key words** in abstract. There is another article published in 1973 by Nizamettin Erbakan et al. But there is no abstract of article in WOS, only title of article.

It is difficult to connect the publications situation only to wars, there are several parameters can be effect to scientific publications (Asan, 2006). In addition, the absence of publications from the selected countries in the pre-1900 and post-1900 years should not mean that there are no publications in these countries, as of 25.7.2019, only journals covered by Web of Science (WOS) are included, but other journals may be publish similar articles. For coverage a journal published between 1900 and 1944 by WOS, the criteria that any article in that journal should have at least 50 citations in WOS journals was used. (http://isiwebofknowledge.com/whatsnew/).

<http://scientific.thomson.com/webofknowledge/backfiles/centuryofscience/centsci-story.html>). Unfortunately, it can be access above sites in 2005 but this information is missing when clicking now and appearing <http://wokinfo.com/>.

In terms of number of publications, the USA, China and India are in the lead, respectively (Table 1). However, the impact values of these 3 countries are not equal; In the other words, there are many publications from China and India but their impact values are lower than the USA. China and India's h index values are also less than the USA. The USA ranks first with 284 h index. The possible reasons for this can be stated as follows: Web of Science has many US journals (according to July 2017 data, WOS are covered 3928 journals are from USA, 28.17 %) (http://mjl.clarivate.com/#scope_notes), so more journal publications originated from USA; it is also believed that US researchers tend to cite USA and European publications, and prefer more to cite publications in English.

1840 publications of Turkey (1606 are fulltext) has contributed 1.34 % (fulltext articles contribution is 1.41 %) to publications in selected countries. Although these values are close to Iran, they are more than Greece. In Greece, however, the impact value is higher than in Turkey (Table 1). Turkey's h index 72, this value is 69 for Greece. The index value of Iran is 55. The USA has the highest index value, followed by England, Germany and the Netherlands. The USA also ranks first in the total number of citations (Table 1). England, Germany, Japan, France, the Netherlands, China and Spain are followed the USA. But considering the impact value, the ranking varies. For example, the total number of citations in Japan is higher than the Netherlands, but the Netherlands has a higher impact value.

The information about the journals in which publications are published most often is as follows. *Mycoses* (among the top 10 in 8 countries), which are generally common in the journals with the highest number of publications from each country. *Fungal Gen. Biol*. (In the top 10 in 6 countries), Plant Dis. and Plos One (top 10 in 5 countries each) and Acta Hort. and Antimicrobial Agents Chemoter. (each of the top 10 in 4 countries). In Brazil and Canada, the situation is different, while the top 5 journals with the most selected keywords come from Canada, while this number is 4 for Brazil, which means that Brazilian and Canadian researchers prefer their own country journals. In this area most publication organization in Turkey within the first 3 rows of Hacettepe, Ege and Istanbul Universities. The most publications in this area which induced a journal in Turkey Fres. Env. Bull. Originated from Germany (54 publications with 2.94 %). Interestingly, this journal is not among the top 10 journals in Germany and in any other selected countries. The fact that the journal is covered by SCI-Expanded and the acceptance of the article is higher than the other SCI-Expanded journals may play a role in this situation. It ranked first in Turkey already existing publications in this journal publications are sourced. As of 25/07/2019 there are 3352 publications in this journal from Turkey, 34.28 % of the publications in journals from Turkey; China ranked second, with 2,374 publications - 24.28% and third with Greece, 719 publications, with 7.35 %; Although the journal originated in Germany, the publications from Germany were ranked 6th in this journal. As of 07/25/2019 scope of Turkey addressed WOS publication 618879 (462799 fulltext articles) took place. The first four journals to be published were Procedia Social and Behavioral Sciences (4809), Fresenius Environmental Bulletin (3352), Turkish Journal of Pediatrics (2567) and Febs Journal (2473).

Information about the year in which publication and citation increases first started is also different. USA, Canada, Japan and the UK gained momentum in the number of publications in the 1970s, the Netherlands, in Italy and India 1980, Germany, France, Spain, Russia, Brazil and Greece in 1990s, Turkey, Iran and China in 2000, it gained momentum in the years. The acceleration in the number of citations received, USA - Canada (1981) and Japan (1975), usually in other countries, except for 1990, while Turkey and Iran, and China has gained momentum in the 2000s. It was noteworthy that publications originating from Japan started to increase the number of citations they received from 1975 before all selected countries, as well as gaining momentum. It is clear that there is an increase in the number of citations as well as the number of publications. As a result, the USA, China, India, Japan and Germany were among the top five countries for publication numbers, but considering the impact value of the publications, the USA, the Netherlands, the UK, France and Germany were the top five countries. Notably, the Netherlands was not in the top 5 in terms of the number of publications, but in terms of the impact value, it ranked second and did not include China, Japan and India. This means that the US ranks first in terms of both the number of publications and the impact value of these publications, which means that the United States has more publications and these publications are cited as sources in other publications. The Netherlands has few publications, but the impact of these publications are very high. China, Japan and India have many publications, but these publications receive less citations than USA and the Netherlands, as well as low impact values.

As can be seen, the publications originating from our country in this field started both late (1977), and the number of publications was low and therefore our contribution rate was low compared to the publications originating in this field

(1.34 %). The increase in the number of publications in this field depends on us as well as other factors. For example, there is no culture collection center for microfungi in international standards in our country. The presence of such a center will increase the number of publications in this field, will contribute to the development of new researchers in this field and will attract the attention of researchers from various countries in this field for our country. According to the latest published report in this field (https://stateoftheworldsfungi.org/2018/reports/SOTWFungi_2018_Full_Report.pdf), these genera and other fungal genera are of great importance.

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NATURALLY GROWING *AGARICUS* SPECIES IN MUĞLA

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ABSTRACT

Agaricus L., known as the world because it contains commercial species, also in Turkey known by names such as 'içi kızıl', 'çimen mantarı', 'çayır mantarı'. *Agaricus* has over 500 species in the world. With the taxonomic studies conducted in our country, 43 species have been identified from the past to the present. It has been stated in previous studies that 13 of these are naturally distributed in Muğla province. Between 2015 and 2018, the distribution of the genus was examined with routine field studies conducted in Muğla.

Key words: *Agaricus*, Muğla, Taxonomy, Macrofungi, Biodiversity.

Muğla'da Doğal Olarak Yetişen *Agaricus* Türleri

ÖZ

Agaricus cinsi, ticari türler içermesi nedeniyle dünyada tanınan, ülkemizde de genel olarak 'içi kızıl', 'çimen mantarı', 'çayır mantarı' gibi isimlerle bilinen bir cinstir. *Agaricus* cinsi dünyada 500'ü aşkın türe sahiptir. Ülkemizde yapılan taksonomik çalışmalarla 43 türü tespit edilmiştir. Bunlardan 13 tanesinin Muğla ilinde doğal olarak yayılış gösterdiği önceki çalışmalarda belirtilmiştir. 2015-2018 yılları arasında Muğla ilinde yapılan rutin araziler ile cinsin dağılımı incelenmiştir.

Anahtar kelimeler: *Agaricus*, Muğla, Taksonomi, Makrofungi, Biyoçeşitlilik.

Introduction

The genus *Agaricus* have a most economically important species in the world. *A. bisporus* (J.E. Lange) Imbach cultured for nutrition and cultured because of its medicinal content *A. blazei* Murrill is the most known of them. Also several members of this genus cause gastrointestinal symptoms. This saprophytes genus, spread in forest openings, meadow areas, parks and gardens and also fertilizer areas are preferred.

Muğla is a city that belongs to the west of Turkey and the Aegean Region (Fig 1). This province has a Mediterranean climate and annual rainfall of more than 1000 mm per square meter, in terms of the rate of forest which is one of Turkey's richest provinces. All these features indicate that the area is suitable for the natural growth of the genus *Agaricus*. The aim of this study was to investigate the diversity of *Agaricus* species in Muğla.

Material and Method

The specimens belonging to genus *Agaricus* that collected from Muğla (2015-2018) is the main materials of this study. Photographs of the collected specimens were taken and their ecological and morphological characteristics were recorded. Microscopic features were also examined and compared with existing literature information to obtain species list (Cappelli, 1984; Knudsen and Vesterhold, 2008; Parra, 2008; Kerrigan, 2016; Kibby, 2017). In the identfy of the members of the genus, whether there is discoloration and some chemical tests (20% KOH and Schäeffer's) are very important. These characteristics were taken into consideration in the identify of specimens.

Results

Agaricus species, which grow naturally in Muğla in 2015-2018, were investigated and 22 species were identified in this study. These species are given below with their localities. In addition, in previous studies, the species belonging to genus *Agaricus* in Muğla are indicated by their locations.

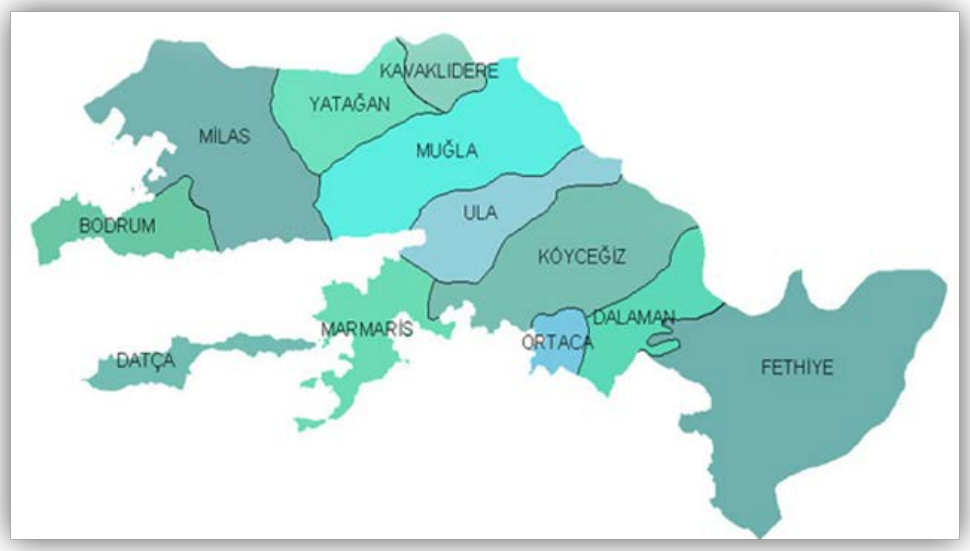

Figure 1: Muğla's districts map

1. ***Agaricus arvensis*** Schaeff.: Çiçekli, Ula, Muğla, in meadow, 19.05.2016, Tırpan 22. Besides the castle of Beçin, Milas, Muğla, in meadow, 05.04.2018, Tırpan 280. Edible (Kalač and Svoboda, 2000).

2. ***Agaricus benesii*** (Pilát) Singer: Çiçekli, Ula, Muğla, in the *Pinus brutia* Ten. forest, 26.12.2017, Tırpan 232. Edible (Breitenbach and Kränzlin, 1995).

Previous studies: Muğla, Ula, near the field, 10.01.2001, FY. 1146 (Solak and Yılmaz Ersel, 2005).

3. ***Agaricus bisporus*** (J.E. Lange) Imbach: Bayır, Menteşe, Muğla, in flower pot, beside the *Hydrangea* sp., 22.04. 2016, Tırpan 9. Gökbel Village, Ortaca, Muğla, 18.11.2016, Tırpan 42. Edible (Kerrigan, 2016).

Previous studies: Ula, center, in field, 15.10.2006, Solak 2184 (Güngör et al., 2016).

4. ***Agaricus bitorquis*** (Quél.) Sacc.: Camping area, Akyaka, Ula, Muğla, *P. brutia* forest, 17.11.2016. Tırpan 41. İçmeler, Marmaris, Muğla, 24.12.2016, Tırpan 56. Ekincik Neighborhood, Köyceğiz, Muğla, 17.03.2018, Tırpan 267. Kötekli, Muğla, in meadow, 31.03.2018, Tırpan 274. Edible (Kerrigan, 2016).

5. ***Agaricus bresadolanus*** Bohus: Toki residences, Muğla, under the *Morus* L., 14.11.2018, Tırpan 329. Poisonous (Karunarathna et al., 2016).

6. ***Agaricus campestris*** L.: Kozbeyli Köyü, Foça, İzmir, 25.10.2015, Tırpan 2. Kötekli, Muğla, 21.04.2016, Tırpan 8. Çiçekli, Ula, Muğla, çimenlik alan, 19.05.2016, Tırpan 20. Kaptan dinlenme tesisleri, Köyceğiz, Muğla, *L. orientalis* Mill. Ormanı, 23.12.2017, Tırpan 226. Geyik kanyonu, Ula, Muğla, 24.10.2018, Tırpan 318. Akyaka azmak kenarı, Ula, Muğla, çimenlik alan, 10.11.2018, Tırpan 322. Edible (Kerrigan, 2016).

Previous studies: Sandras Mountain, 23.12.2000 (Işıloğlu, 2001). Ula, center, in garden, 29.9.2006, Solak 2179; 16.5.2006, Solak 2168; in field, 15.10.2006, Solak 2186 (Güngör et al., 2016).

7. ***Agaricus cupreobrunneus*** (Jul. Schäff. & Steer) Pilát: Bayır, Menteşe, Muğla, *Olea europaea* L., 14. 02. 2016, Tırpan 7. Derinkuyu mah., Ula, Muğla, 09.11.2018, Tırpan 320. Edible (Ouzouni et al., 2007).

Previous studies: Ula, Yayla place, in garden, 16.10.2005, Solak 1548 (Güngör et al., 2016).

8. ***Agaricus devoniensis*** P.D. Orton: İçmeler, Marmaris, Muğla, in sandy soil, 07.04.2018, Tırpan 281. Edible (Kerrigan, 2016).

9. ***Agaricus dulcidulus*** Schulzer: Aktur Kovanlık, Datça, Muğla, near the *P. brutia* Ten. forest, 25.12.2016, Tırpan 86. Poisonous (Karunarathna et al., 2016).

10. ***Agaricus gennadii*** (Chatin & Boud.) P.D. Orton: Turgutreis, Bodrum, Muğla, çimenlik alan, 17.12. 2016, Tırpan 82. Edible (Bohus,1975).

Previous studies: Ulukent, Ula, Muğla, 25.04.2006, Solak 2165 (Alkan et al., 2012).

11. ***Agaricus langei*** (F.H. Møller) F.H. Møller: Çiçekli, Ula, Muğla, *P. brutia* Ten. forest, 26.12.2017, Tırpan 234. Edible (Breitenbach and Kränzlin, 1995).

12. ***Agaricus lanipes*** (F.H. Møller & Jul. Schäff.) Hlaváček: Near the Azmak river, Akyaka, Ula, Muğla, under the *Eucaliptus* sp., 25.10.2018, Tırpan 319. Edebility is unknown.

13. ***Agaricus litoralis*** (Wakef. & A. Pearson) Pilát: Çiftlikköy, Milas, Muğla, in meadow, 05.04.2018, Tırpan 278. Ula, Muğla, near the *P. brutia* Ten. forest, 17.11.2018 Tırpan 341. Edible (Galli, 2004).

14. ***Agaricus lutosus*** F.H. Møller: Municipal Cemetery, Köyceğiz, Muğla, 10.12.2017, Tırpan 218. Edible (Pereira, 2012).

15. ***Agaricus macrocarpus*** F.H. Møller: Çiçekli, Ula, Muğla, near the *P. brutia* Ten. forest, 26.12.2017, Tırpan 231. Edible (Pereira, 2012).

16. ***Agaricus moelleri*** Wasser: Mesudiye Village, Datça, Muğla, 24.12.2016, Tırpan 58. Çiçekli, Ula, Muğla, *P. brutia* Ten. forest, 26.12.2017, Tırpan 233. Derinkuyu, Ula, Muğla, 09.11.2018, Tırpan 321. Poisonous (Priyamvada et al., 2017).

17. ***Agaricus pampeanus*** Speg.: İztuzu, Gökbel, Ortaca, Muğla, 20.12.2016, *P. brutia* ormanlık alan, Tırpan 53. Akyaka, Muğla, 03.12.2018, Tırpan 360. Edible (Kerrigan, 2016).

Previous studies: Ula, Yayla place, in garden, 16.10.2005, Solak 1547 (Güngör et al., 2016).

18. ***Agaricus pseudopratensis*** (Bohus) Wasser: Çiçekli, Ula, Muğla in meadow, 19.05.2016, Tırpan 19. Kötekli, Muğla, in meadow, 31.03.2018, Tırpan 275. Besides the castle of Beçin, Milas, Muğla, in meadow, 05.04.2018, Tırpan 280. Poisonous (Breitenbach and Kränzlin, 1995).

19. ***Agaricus sylvaticus*** Schaeff.: Mesudiye köyü, Datça, Muğla, *P. brutia* Ten. forest, 24.12.2016, Tırpan 59. Dalyan, Muğla, near the *P. brutia* Ten. forest, 23.12.2017, Tırpan 227. Akyaka camping area, Muğla, *P. brutia* Ten. forest, 15.12.2018, Tırpan 371. Edible(Breitenbach and Kränzlin, 1995).

20. ***Agaricus sylvicola*** (Vittad.) Peck: Bayır, Menteşe, Muğla, near the *Olea europaea* L., 14.02. 2016, Tırpan 6. Tepearası, Ortaca, Muğla, *Liquidambar orientalis* Mill. forest, 07.12.2017, Tırpan 217. Çiçekli, Ula, Muğla, *P. brutia* Ten. forest, 26.12.2017, Tırpan 230. Edible(Kerrigan, 2016).

21. Agaricus urinascens (Jul. Schäff. & F.H. Møller) Singer: Çubucak, Datça, Muğla, *P.brutia* Ten. forest, 24.12.2016, Tırpan 60. Edible (Breitenbach and Kränzlin, 1995).

22. ***Agaricus xanthodermus*** Genev.: Akyaka, Muğla, çimenlik alan, 26.04.2016, Tırpan 11. Gökbel village, Ortaca, Muğla, 20.12.2016, near the *P. brutia* forest, Tırpan 54, Tırpan 55. Poisonous (Kerrigan, 2016).

Previous studies: Sandras Mountain, 21.11.1998 (Işıloğlu, 2001). Fethiye, Arpacık village, Gedre district, Akçaoluk place, in *Pinus* sp. forest, 4.11.2006, Solak 2614 (Güngör et al., 2016).

Discussion

Some of the species found previously in Muğla were re-collected in this study. But some of them have not been found although we went to their original location. This species;

Agaricus comtulus Fr.: Fethiye, Kargı village, in meadow, 11.11.2007, Solak 3345; Çengelköy, Belenkavak place, in *Pinus* sp. forest, 11.11.2007, Solak 3399; Ula, Çiçekli village, in *Pinus* sp. forest, 27.11.2007, Solak 3489 (Güngör et al., 2016). Edebility is unknown (Kerrigan, 2016).

Agaricus depauperatus (F.H. Møller) Pilát: Muğla, Ula, near the road side, 10.01.2001, FY. 1147 (Solak and Yılmaz Ersel, 2005). Edebility is unknown (Kerrigan, 2016).

Agaricus impudicus (Rea) Pilát : In Muğla (Işıloğlu and Öder, 1995, Sesli and Denchev 2014). Edible (Ágreda et al., 2014).

Agaricus iodosmus Heinem.: Ula, Çiçekli village, in *Pinus* sp. forest, 27.11.2007, Solak 3488 (Güngör et al., 2016). Poisonous (Kerrigan, 2016).

Agaricus porphyrizon P.D. Orton: Fethiye, Arpacık village, Gedre district, Akçaoluk place, in *Pinus* sp. forest, 4.11.2006, Solak 2615 (Güngör et al., 2016). Edible (Breitenbach and Kränzlin, 1995).

Agaricus semotus Fr.: Fethiye, Arpacık village, Gedre district, Akçaoluk place, in *Pinus* sp. forest, 4.11.2006, Solak 2603 (Güngör et al., 2016). Poisonous (Yang et al., 2005).

In addition, 15 species (*A. arvensis, A. bitorquis, A. bresadolanus, A. devoniensis, A. dulcidulus, A. langei, A. lanipes, A. litoralis, A. lutosus, A. macrocarpus, A. moelleri, A. pseudopratensis, A. sylvaticus, A. sylvicola, A. urinascens*) are identified for the first time in Muğla with this study. As a result of this research, the number of species of the genus

Agaricus in Muğla province increased from 13 to 28. Seven of these 28 species (*A. bresadolanus*, *A. dulcidulus*, *A. iodosmus*, *A. moelleri*, *A. pseudopratensis*, *A. semotus*, *A. xanthodermus*) are poisonous and are known to cause gastrointestinal symptoms, although no mortal cases have been reported.

The specimens collected in this research are storing in Muğla Sıtkı Koçman University, Cryptogame Laboratory.

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AGARICUS SPECIES BIODIVERSITY OF MANİSA

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ABSTRACT

Agaricus L. (*Agaricaceae, Basidiomycota*) is a large and popular genus comprising more than 500 species worldwide that are common in forests or grasslands. Forty three species grow naturally in Turkey. In Manisa province, 6 species belonging to the genus Agaricus have been reported in previous studies. Field studies were conducted between 2015-2018 and the distribution of the genus in the province was examined in detail.

Key words: *Agaricus*, Manisa, Taxonomy, Macrofungi, Biodiversity.

Manisa'nın *Agaricus* Cinsi Biyoçeşitliliği

ÖZ

Agaricus L. (*Agaricaceae, Basidiomycota*), dünya çapında ormanlarda veya çayırlarda yaygın olan 500'den fazla türü içeren büyük ve popüler bir cinstir. Türkiye'de 43 türü doğal olarak yetişmektedir. Manisa ilinde ise *Agaricus* cinsine ait 6 türün yetiştiği önceki çalışmalarda rapor edilmiştir. 2015-2018 yılları arasında arazi çalışmaları ile cinsin ildeki yayılışı detaylı olarak incelenmiştir.

Anahtar kelimeler: *Agaricus*, Manisa, Taksonomi, Makrofungi, Biyoçeşitlilik.

Introduction

The genus Agaricus L., is a member of the family Agaricaceae Chevall.belonging to the phylum Basidiomycota Whittaker Ex Moore. The saprotrophic genus can be easily distinguished in nature with, lamellae that pinkish when young, then brown tones, usually have a distinct ring in the stalk and fleshy cap structure. Although the genus is easy to distinguish, the species is difficult to distinguish. There are also some mild poisonous species of the genus, which have acquired a very large place in world kitchens and traditional medicine since the present day. Agaricus genus, which contains more than 500 species in the world and 43 species in our country, has 6 members in Manisa province (Sesli and Denchev, 2014). Manisa is a province in the Aegean Region that does not have a shore (Fig 1). Manisa have a Mediterranean climate and a continental climate and 46% of the land is covered with forests and shrubs. Due to such characteristics, it has favorable conditions for the development of species belonging to the genus. The main objective of this study is to determine the natural *Agaricus* species in Manisa.

Material and Method

Between 2015 and 2018, the natural spread of the genus in this province was re-examined through field studies. The photographs of the collected samples were taken in their area, ecological characteristics and potential of the color change when bruised were recorded with the specimen numbers. In addition to the macroscopic, microscopic and ecological characteristics, 20% KOH and Schaeffer's cross test results are important in determining the taxonomic places of the members. For the specimens identify, the diagnostic keys in the literature were followed, taking into account every detail. The main sources used in the identification of species are; Cappelli, 1984; Knudsen and Vesterhold, 2008; Parra, 2008; Kerrigan, 2016; Kibby, 2017.

Figure 1: Manisa's districts map

Results

In previous studies conducted by mycologists, 6 *Agaricus* species from Manisa province were reported. In this study, all the *Agaricus* species previously reported from the research area were obtained. Also, 11 species were reported in addition to the species identified in Manisa. Species identified in the research are;

1. *Agaricus altipes* (F.H. Møller) F.H. Møller: Çelikli Village, Salihli, Manisa, 30.10.2017, Tırpan 157. Edible (Şen et al., 2012).

2. *Agaricus benesii* (Pilát) Pilát: Süreyya Nature Park, Kayapınar Village, Manisa 29.10.2017 Tırpan 156. Edible (Breitenbach and Kränzlin, 1995).

3. *Agaricus bernardii* Quél.: Dere, Şehzadeler, Manisa, 28.10.2016, Tırpan 23. Edible (Kerrigan, 2016). But it is not preferred because it smells bad (Møller, 1950).

4. *Agaricus bisporus* (J.E. Lange) Imbach: Gökçeahmet village, Akhisar, Manisa, in meadow, 19.11.2016, Tırpan 46. Edible (Kerrigan, 2016).

Previous studies: In Manisa (Yılmaz et al., 1997; Sesli and Denchev, 2014). Yağcılar village, Muradiye, Manisa, in meadow, 04.12.1998, Solak 1097 (Solak and Yılmaz 2002).

5. *Agaricus bitorquis* (Quél.) Sacc.: Spil Mountain, Manisa, in meadow,14.05.2016, Tırpan 13. Çapaklı village, Salihli, Manisa, in the *Olea europaea* L. field, 30.10.2017, Tırpan 160. Dombaylı village, Salihli, Manisa, in meadow, 15.11.2018, Tırpan 330. Edible (Kerrigan, 2016).

Previous studies: In Manisa (Gücin and Öner, 1982; Sesli and Denchev, 2014). Akhisar, Manisa, in meadow, 09.11.1994, Solak 10 (Solak and Yılmaz 2002).

6. *Agaricus campestris* L.: Mesir Nature Park, Manisa, 14.05.2016, Tırpan 14. Akhisar, Manisa, in meadow, 19.11.2016, Tırpan 47. Tekeli Işıklar village, Soma, Manisa, in meadow, 13.05. 2017, Tırpan 111. Spil Mountain, horse rearing area, Manisa, 24.10.2017, Tırpan 149. Güzelyurt, Manisa, 28.12.2017, Tırpan 263. Edible (Kerrigan, 2016).

Previous studies: Yağcılar village, Muradiye, Manisa, in meadow, 01.12.1998, Solak 1091 (Solak and Yılmaz 2002).

7. *Agaricus cupreobrunneus* (Jul. Schäff. & Steer) Pilát: Gürle, Manisa, 28.12.2017, Tırpan 264. Edible (Ouzouni vd. 2007).

Previous studies: In Manisa (Yılmaz et al., 1997; Sesli and Denchev, 2014).

8. *Agaricus impudicus* (Rea) Pilát : Çelikli Village, Salihli, Manisa, *Pinus brutia* Ten.- Q*uercus* sp. mixed forest, 30.10.2017, Tırpan 158. Edible (Ágreda et al., 2014).

9. *Agaricus iodosmus* Heinem.: Spil Dağı, Manisa, horse rearing area, in meadow, 24.10.2017, Tırpan 145. : Poisonous (Kerrigan, 2016).

10. *Agaricus langei* (F.H. Møller) F.H. Møller: Tekeli Işıklar Village, Soma, Manisa, in meadow, 13.05. 2017, Tırpan 112. Edible (Breitenbach ve Kränzlin, 1995).

11. *Agaricus luteomaculatus* F.H. Møller: Uncubozköy, Manisa, 19.11.2016,Tırpan 44. Edible (Breitenbach ve Kränzlin, 1995).

12. *Agaricus macrocarpus* F.H. Møller: Çortak, Selendi Manisa, in meadow, 15.11.2018, Tırpan 332. Edible (Breitenbach ve Kränzlin, 1995).

13. *Agaricus moelleri* Wasser: Dere, Şehzadeler, Manisa, 18.10.2016, Tırpan 24. Eldelek Village, Salihli, Manisa, 30.10.2017, Tırpan 161. Güzelyurt, Manisa, 28.12.2017, Tırpan 262. Poisonous (Priyamvada et al., 2017).

14. *Agaricus pseudopratensis* (Bohus) Wasser: Spil Mountain, Manisa, in meadow,14.05.2016, Tırpan 12. Poisonous (Breitenbach and Kränzlin, 1995).

Previous studies: Yağcılar village, Muradiye, Manisa, in meadow, 01.12.1998, Solak 1093 (Solak and Yılmaz 2002).

15. *Agaricus sylvaticus* Schaeff.: Kobaşdere, Akhisar, Manisa, 19.11.2016, Tırpan 45. Sevişler Village, Soma, Manisa, *P. brutia*, *Quercus* sp. mixed forest, 30.10.2017, Tırpan 159. Manisa urban forest, 24.03.2018, under the *P. brutia*, Tırpan 269. Çortak, Selendi Manisa, 15.11.2018, Tırpan 333. Edible (Breitenbach ve Kränzlin, 1995).

16. *Agaricus urinascens* (Jul. Schäff. & F.H. Møller) Singer: Mesir Nature Park, Manisa, 14.05.2016, Tırpan 15. Spil Mountain, horse rearing area, Manisa, 24.10.2017, Tırpan 148. Edible (Breitenbach ve Kränzlin, 1995).

17. *Agaricus xhantodermus* Genev.: Kobaşdere, Akhisar, Manisa, in meadow, 19.11.2016, Tırpan 45. Gökçeahmet village, Akhisar, Manisa, in meadow, 19.11.2016, Tırpan 48. Eldelek village, Salihli, Manisa, 30.10.2017, Tırpan 162. Manisa urban forest, 24.03.2018, under the *P. brutia*, Tırpan 268. Pınarlar, Selendi, Manisa 15.11.2018, Tırpan 331. Poisonous (Kerrigan, 2016).

Previous studies: Horozlu village, Manisa, in the *Pinus* sp. forest, 10.09.1995, Solak 37 (Solak and Yılmaz 2002).

Discussion

With this study, the number of naturally growing members of the *Agaricus* species in Manisa province was updated to 17. Four of these species (*A. iodosmus, A. moelleri, A. pseudopratensis and A. xanthodermus*) which are determined to grow naturally in Manisa, are poisonous. This type of poisoning causes gastrointestinal symptoms, not lethal. The remaining 13 species are edible and some of them are known and collected by the human which are living in Manisa.

These species were identified as a result of the research, Muğla Sıtkı Koçman University is kept as a fungaryum material in Cryptogame Laboratory.This study was supported with Muğla S.K. University Scientific Research Projects Coordination Unit (BAP) project number 17/102.

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SHIITAKE *(LENTINUS EDODES)* MANTARININ LİNTER ATIĞI ÜZERİNDEKİ KÜLTÜRASYONU, MORFOLOJİK VE KİMYASAL ÖZELLİKLERİNİN ARAŞTIRILMASI

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ÖZ

Bu çalışmada, linter atığının *Lentinus edodes* mantarı yetiştiriciliğinde kullanım olanakları araştırılmıştır. *Lentinus edodes* mantarının tohumluk miselleri kontrol örneği olarak kullanılan meşe odunu talaşına ve pamuk tohumu küspesi olan lintere farklı oranlarda katılarak, kompost (100 linter, % 75 linter + % 25 meşe, % 50 linter + % 50 meşe, % 25 linter + % 75 meşe) ortamlarına aşılanmıştır. Sonra, misel gelişimi sağlanan ortamlar belirlenmiştir. Ortamların özelliklerinin belirlenmesi amacı ile karbon, azot ve karbon/azot miktarları tespit edilmiştir. Yapılan ölçümlerde, ortamlar üzerine aşılı *Lentinus edodes*'in misel gelişme süresi, mantar eldesi süresi, toplam verim, biyolojik etkinlik oranı ve mantar kalite özellikleri belirlenmiştir. Ayrıca elde edilen mantar örneklerinin kansere karşı etken maddesi olan lentinan miktarı, yağ asidi içerikleri ve flavanoid olmayan fenolik asit içerikleri de ortaya konmuştur.

Çalışmada elde edilen bulguların sonuçları, %50 linter + % 50 meşe % 25 linter + % 75 meşe talaşı ortamlarından ürünler elde edildiğini göstermiştir. Söz konusu ürünler, genel yetişme ortamı olan meşe talaşında yetiştirilen mantarlarla karşılaştırıldığında, daha yüksek verim, 2 hasat dönemi göz önünde bulundurulduğunda düşük mantar eldesi ve biyolojik etkinlik, daha iyi morfolojik özellikler tespit edilmiştir. Ayrıca, lentinan miktarının oldukça yüksek olduğu tespit edilmiştir. Yağ asidi içeriğinde linoleik asit ve palmitik asit, yüksek oranlarda bulunmuş, ilaveten flavanoid olmayan fenolik asit içeriğinde salisilik ve fumarik asit yüksek oranlarda oluşmuştur.

Anahtar kelimeler: *Lentinus edodes*, Kompost, Verim, Lentinan

Investigation of Cultivation on Linter Wastes, Morphological and Chemical Properties of Shiitake *(Lentinus edodes)* Mushrooms

ABSTRACT

In this study, the using possibilities of linter waste in *Lentinus edodes* mushroom cultivation were investigated. The spawn of *Lentinus edodes* fungus were inoculated into compost adding at different rates (100% linter, 75% linter + 25% oak, 50% linter + 50% oak, 25% linter +75% oak) to oak wood sawdust used as a control samples and linter (cottonseed residue). Then, the compost with mycelia growth were determined. Carbon, nitrogen and carbon / nitrogen amounts were determined in order to determine the properties of the media. In the measurements, growth time of mycelia, fungal production time, total yield, biological activity rate and fungus quality characteristics of *Lentinus edodes* grafted on the compost were researched. In addition, the amount of lentinan, the fatty acid content and non-flavanoid phenolic acid content of the anti-cancer activity ingredient of the obtained fungal samples were also revealed. The results of the study showed that products were obtained from habiats of 50% linter + 50% oak and 25% linter + 75% oak sawdust. Compared to the mushrooms grown in oak sawdust, which is the general growing medium, in the test products were obtained from higher yield, and lower fungal yield and biological efficiency when two harvest periods were considered, better morphological properties were gained. In addition, the amount of lentinan was found to be quite high. Linoleic acid and palmitic acid in fatty acid content were found to be high, in addition, salicylic and fumaric acid in non-flavanoid phenolic acid content were comprised the high proportions.

Key words: *Lentinus edodes*, Compost, Yield, Lentinan

1.Giriş

Dünyada ve ülkemizde tarımsal, endüstriyel ve daha birçok atık türü çevre de büyük bir yük ve insan sağlığına olumsuz etki teşkil etmektedir. Potansiyel yükün çevreye herhangi bir zararı olmaksızın bertaraf edilmesi büyük önem taşımaktadır. Atıkların kullanılarak çevreye ve insan sağlığına faydalı ve uygun ürünler geliştirilmenin önemi her geçen gün artmaktadır. Daha çok tarımsal atıklar kullanılarak yetiştirilen ve birim alandan en fazla ürün alınabilen üretim dalı kültür mantarcılığıdır. Kültür mantarcılığı ile atıkların değerlendirilerek çevreye olan yükün azalacağı ve atıkların, kullanılarak değerli ürüne dönüştürülmesi, iç ve dış pazar açısından önemli gelir kaynağı olacağı düşünülmektedir.

Özellikle, yenilebilir mantarlar, kompleks organik molekülleri, basit bileşiklere dönüştürebilmek için gerekli olan enzim mekanizmasına sahiptirler (Martinez ve ark., 1994). Bu biyoteknolojik yaklaşım, başka alanlarda kullanılmayan ve potansiyel olarak kirlilik meydana getirebilecek olan tarımsal artıkların, yüksek protein ve vitamin içeriğine sahip besine ve yüksek tıbbi özellikleri olan kaynağa dönüşmesi açısından büyük öneme sahiptir (Rambelli, 1983).

Yenilebilen ve yenilemeyen mantarların birçoğu güney ve doğu Asya'da tıbbi amaçlarla uzun zamandan beri kullanılmaktadır. Bunların çoğu günümüzde tıp uygulamalarında kullanılmaktadır. Özellikle en güçlü etki ve kullanım alanı bulan türler Ganoderma türleri, Lentinus edodes, Schizophyllum commune, Tremella fusiformis, Trametes versicolor, Corifola frondosa ve Hericium erinaceus'dir. Günümüzde 270 mantar türü tedavi edici özelliklere sahip olduğu bilinmektedir (Ying ve ark., 1987).

Özellikle bu mantarların immunoloji ve anti kanser özellikleri, anti oksidan, anti hipertansif, karaciğer koruma etkinliği, antifibrotik, anti diabetik, antiviral ve antimikrobiyal özellikleri ile kolesterol düşürücü etkinliği bu yöndeki çalışmaların artmasına sebep olan faktörlerin başında gelmektedir. Uzak doğuda faaliyet gösteren ilaç fabrikaları tıbbi mantarların çok önemli biyomedikal moleküllerin bitmeyen kaynağı olarak görülmektedir. Basidiomycete mantarların ürettiği birçok polisakkarit ve bağlı proteinler uluslararası kanser enstitüsü tarafından anti tümör kimyasalları olarak üretilmektedirler (Jong ve Donovick, 1989).

Endüstriyel atık sınıfına giren linter, pamuktan elde edilen tohum lifleridir. Yağ fabrikasında, pamuk çekirdekleri linter testeresinden geçirilir ve pamuk linteri, çekirdekten ayrıştırılarak elde edilmektedir(Dobo ve Kobe, 1957). Tüm pamuk yağı üreten fabrikalarda atık olarak bulunmaktadır.

Yapılan çalışmada, atık halde bulunan linter atığının, tıbbı açıdan öneme sahip olan Lentinus edodes mantarının kültürasyonu, verim ve kalite özellikleri üzerine etkisi, elde edilen mantarın kimyasal bileşimine ve lentinan miktarına olan etkisi araştırılmıştır.

2.Materyal Ve Yöntem

Denemede kullanılan *Lentinus edodes* mantarının tohumluk miselleri Agro Mantarcılık Şirketi'nden temin edilmiştir. Deneme süresince standart tohum hazırlama tekniğiyle talaş üzerine sardırılarak elde edilen tohumluk miseller deneme materyali olarak kullanılmıştır.

Denemede, kompost materyal olarak kullanılan linter atığı, Kahramanmaraş dok yağları fabrikasından, meşe talaşı, Kahramanmaraş odun ambarından temin edilmiştir.

Ortamlar %100 Linter, %75 Linter+%25 Meşe (3L+M), %50 Linter+%50 Meşe (L+M), %25 Linter+%75 Meşe (L+3M) olarak hazırlanmıştır.

2.1.Misellerin çoğaltılması ve tohumluk misel eldesi

Misellerin çoğaltılmasında malt agar besi ortamı kullanılmıştır. Mantar miselinden yaklaşık 1 cm^2 hazır hale gelen besi yerinin merkezine aşılanarak, 25 °C'de % 65 bağıl nemde geliştirilmiştir. Petrilerde mantarın gelişimi yaklaşık 3 hafta sürmüştür.

Tohumluk misel üretimi için, meşe odunu yongaları uygun nem % 70 ve pH 5'e getirilmiştir. Ardından hazırlanan yongalar 250 ml' lik cam kavanozlara doldurularak 121 °C de 90 dk muamele edilmiştir. Sterilize edilmiş meşe odunu yongaları, soğutulduktan sonra petrilerde geliştirilen misellerden yaklaşık 5 cm^2 koyularak, gelişimi sağlanmıştır. Gelişim yaklaşık 1,5 ay sürmektedir.

2.2. Yetiştirme ortamlarının hazırlanması

Denemede, *Lentinus edodes* mantarının doğal yetişme ortamı olan meşe talaşı (Stamets, 1993) kontrol olarak kullanılmıştır. Potansiyel olarak incelenen endüstriyel atık tek başına ve bunun 3:1, 1:3 ve 1:1 oranında ağırlık üzerinden kontrolle karışımları hazırlanmıştır. Ortamların hazırlanmasında meşe talaşı (kontrol) ve linter atığı kullanılmıştır.

Yetiştirme ortamlarının rutubet içerikleri çeşme suyu ile belirli sürelerde ıslatılarak sağlanmıştır. Ortamlar istenilen neme ulaşıncaya kadar 2 gün süre ile ıslatılmış, her gün karıştırılarak homojen nem içeriğinin oluşması sağlanmıştır. Ortamların pH'sını ayarlamak için, materyalleri poşetlemeden önce pH metre yardımıyla ölçüm yapılmış ve bu ölçüm sonucuna göre alçı ve kireç eklenmiştir.

2.3. Sterilizasyon ve ekim işlemi

Linter içerikli ortamlar 1 kg olacak şekilde doldurulmuştur. Torbaların ağzı pamuk tıkaçla kapatılmış ve klipsle bağlanmıştır. Zararlı organizmaları yok etmek amacıyla otoklavda 121 °C'de 90 dk sterilize edilen yetiştirme ortamları, daha sonra otoklavdan çıkartılarak soğumaya bırakılmıştır.

Daha sonra *Lentinus edodes* tohumluk miselleri, LF'ye taşınarak ekim işlemine başlanmıştır. Bu işlem için 50 g tohumluk misel kompost içerisine karıştırılarak aşılama işlemi gerçekleştirilmiştir. Aşılama işleminden sonra, poşetlerin ağzı pamuk tıkaçla kapatılarak 25 °C ayarlanmış ve % 70 – 80 nem içeren odalara yerleştirilmiştir.

2.4. İnkubasyon ve hasat işlemi

Misel gelişimi tamamlanmış ortamlar mantar üretimini hızlandırmak için, su sıcaklığı 0 °C'ye ayarlandıktan sonra su içerisine batırılarak, yaklaşık olarak 24 saat bu şekilde tutulmuştur. Daha sonra buzlu sudan çıkartılarak 16-18 °C'deki mantar üretim odasına yerleştirilmiştir. Bu dönemde ortamların kurumasını önlemek için ayrıca yetiştirme odasının nemi % 80 – 90'a çıkartılmıştır. Havalandırma belirli aralıklarla hava değişimini sağlayacak şekilde havalandırma motoru ile yapılmıştır

2.5. Çalışmada yapılan ölçümler

Tarımsal artıkların özelliklerinin belirlenmesi amacı ile yapılan analizler:

Yetiştirme ortamlarının hazırlığında ilk olarak pH ve % rutubet değerleri belirlenmiştir. Artıkların özelliklerinin tespit edilmedi amacı ile ortamlarında sterilizasyon sonrası, misel gelişimini tamamladıktan sonra ve hasat sonunda olmak üzere toplam 3 dönemde örnekler alınmıştır. Misel gelişimini ve hasat sonunu tamamlayan örnekler için torbanın dış yüzeyine gelen kısmı yaklaşık 1,5 cm kaldırılarak torbanın orta yerinden ortamı temsil edecek miktarda örnekler alınmıştır. Daha sonra aşağıdaki yöntemlere göre azot, karbon miktarı ve C:N oranı hesaplanmıştır ve ortamların kimyasal içerikleri belirlenmiştir.

Ph miktarının belirlenmesinde, pH metre kullanılmıştır.

Nem içeriğinin belirlenmesinde, her uygulama için alınan örneklerin yaş ağırlıkları belirlenmiş, daha sonra 65 °C'ye ayarlı etüvde sabit ağırlığa gelinceye kadar kurutulmuştur. Aşağıdaki denklemde (2.1) ortamların % rutubet içerikleri belirlenmiştir:

$$\%R = \frac{R2 - R1}{R2} * 100 \qquad (2.1)$$

%R = yüzde rutubet

R2 = yaş ağırlık (g)

R1 = kuru ağırlık (g)

Toplam azot miktarının belirlenmesinde, kurutulup öğütülen örneklerde % azot tayini modifiye edilmiş Kjeldahl yöntemine göre yapılmıştır.

Karbon miktarının belirlenmesinde, 100'den kül miktarı çıkarılarak elde edilen organik maddenin, % 50' si karbon olarak hesaplanmıştır.

C:N oranının belirlenmesinde, hesaplanan karbon miktarının, azot miktarına oranlaması ile bulunmuş değerdir.

Protein miktarı ise bulunan azot değerinin 6,25 faktörüyle çarpılması ile hesaplanmış ve % olarak ifade edilmiştir.

Verim ile ilgili ölçümler:

Misel gelişim hızı, denemedeki bütün uygulamalarda tohumluk misel aşılamasından itibaren misellerin torbanın her tarafını sarıncaya kadar geçen süre gün olarak hesaplanmıştır. Hasat süresi misel gelişiminden sonra mantar elde edilene kadar geçen gün olarak belirlenmiştir. Mantar eldesi bu iki sürenin toplamı olarak alınmıştır.

Toplam verim, denemedeki bütün uygulamalarda her gün yapılan hasattan elde edilen mantarlar ayrı ayrı tartılmış ve toplanan ürün miktarı toplam verim (g/torba) olarak değerlendirmeye alınmıştır.

Biyolojik etkinlik oranı, her uygulamanın, % biyolojik etkinlik oranı aşağıdaki denklemde (2.2) belirtildiği şekilde hesaplanmıştır.

$$\%BE = \frac{M.A}{S.A} * 100 \quad (2.2)$$

%BE = yüzde biyolojik etkinlik

M.A = taze mantar ağırlığı (g)

S.A = kuru substrat ağırlığı (g)

Mantar kalitesi ile ilgili yapılan analiz ve ölçümler:

Her mantarın fiziksel analizlerinde ağırlık ölçümleri ±0,01 g duyarlıkta teraziyle, uzunluk ve çap ile ilgili ölçümler ise ±0,1mm duyarlıkta kumpas yardımıyla gerçekleştirilmiştir. Fiziksel analizlerde yapılan ölçümler aşağıda belirtilmiştir.

Mantar ağırlığının belirlenmesinde, mantar (sap + şapkanın) tartılmış ve g olarak ifade edilmiştir.

Şapka çapının belirlenmesinde, şapkanın en geniş ve en dar yerinden cm olarak yapılan kumpas ölçümlerinin ortalamaları alınarak tespit edilmiştir.

Sap çapının belirlenmesinde, sapın şapka ve ortam yüzeyi ile birleştiği kısım ile sapın orta noktasından cm olarak yapılan üç kumpas ölçümünün ortalaması alınarak bulunmuştur.

Sap uzunluğunun belirlenmesinde, sapın şapka ile ortam yüzeyine bağlandığı yer arasındaki mesafe cm cinsinden sap uzunluğu olarak belirtilmiştir.

Kuru maddenin belirlenmesinde, taze mantar örnekleri tartılarak % kuru madde tayinleri gerçekleştirilmiştir. Bu amaçla alınan örnekler 65 °C'de ki kurutma dolabında ağırlığı sabit kalana kadar bırakılmış ve hassas terazide kuru ağırlıkları bulunmuştur. Kuru ağırlığın taze ağırlığa bölünmesi ve yüz ile çarpılması ile örneklerin % kuru madde miktarları tespit edilmiştir.

Mantar sertliğinin belirlenmesinde, örneklerin yüzeyindeki iki farklı noktadan (Kg kuvvet) penetrometre yardımıyla ölçülerek ortalamaları belirlenmiştir.

Shiitake mantarında yapılan kimyasal analizler

Protein miktarının belirlenmesi

Kurutulup öğütülen mantar örneklerinde azot tayini modifiye edilmiş Kjeldahl yöntemine göre yapılmıştır. Protein miktarı ise bulunan azot değerinin 6,25 faktörüyle çarpılması ile hesaplanmış ve % olarak ifade edilmiştir.

Shiitake mantarının lentinan miktarının belirlenmesi

Yap ve Ng (2001) tarafından geliştirilen lentinan izolasyonu metoduna göre lentinan elde edilmiştir.

Shiitake mantarının yağ asidi miktarının belirlenmesi

Shimadzu marka GC-FID cihazında, 60 metre uzunluğundaki TRCN-100 markalı kolon kullanılarak mantarların yağ asidi analizi yapılmıştır.

Shiitake mantarı ekstraksiyonu ve flavanoid olmayan fenolik asit içeriğinin belirlenmesi

Flavanoid olmayan fenolik asit içeriğinin belirlenmesi için yüksek performanslı sıvı kromatografisi (HPLC-UV) cihazı (Shimadzu marka) kullanılmıştır. Elde edilen mantarlar 200 ml. methanol içerisinde 100 C°de 1 saat ekstrakte edilerek HPLC-UV cihazında test edilmiştir.

Çalışma kapsamında elde edilen veriler, SPSS istatistiksel paket programı kullanılarak ve % 95 güven düzeyi esas alınarak analiz edilmiş ve bunlar arasındaki istatistiksel farklılık varyans analizi ile ortaya konmuştur.

3.Bulgular Ve Tartışma

3.1. Ortamların pH, % rutubet, % karbon, % azot ve karbon/azot miktarları

Yapılan çalışmada hazırlanan ortamların pH değişim miktarına ait bulgular Tablo 1'de verilmektedir.

Tablo1. Ortamların sterilizasyon sonu, misel gelişim sonu ve hasat sonu pH değişimleri

Ortamlar	pH		
	Sterilizasyon Sonu	Misel Gelişim Sonu	Hasat Sonu
Linter	7,8	4,03	hs*
3L + M	7,49	3,98	hs*
L + M	7,46	3,81	4,21
L + 3M	7,32	3,69	3,99

* Ürün alınamamış ortamlar hs ile gösterilmiştir

Hazırlanan ortamların mantar aşılama işlemi yapılmadan önceki ph'ı 7,32 ile 7,80 arasında değişiklik göstermektedir. Rutubet içeriği minimum %60 seviyesinde tutulmaya çalışılmış ve örneklerin su tutma kapasitesine göre %63 ile %68 arasında bulunmuştur. Sterilizasyon sonu ile misel gelişimi sonu arasındaki pH azalımı, misel gelişimi sırasında *Lentinus edodes* mantarının degredasyonu sırasında salgıladığı enzimlerin neden olduğu tahmin edilmiştir. Misel gelişim sonu ile hasat sonu arasındaki pH miktarındaki hafif artışın, degredasyon hızının yavaşlamasından kaynaklandığı düşünülmektedir.

Tablo 2. Aşılama öncesinde ortamların karbon, azot, karbon/azot oranı ve protein miktarları

Ortamlar	Aşılama öncesindeki ortam içerikleri			
	Karbon (%)	Azot (%)	Karbon/azot	Protein (%)
Linter	40,219	2,076	19,372	12,976
3L + M	40,629	1,842	22,063	11,509
L + M	41,039	1,607	25,539	10,043
L + 3M	41,449	1,372	30,204	8,577

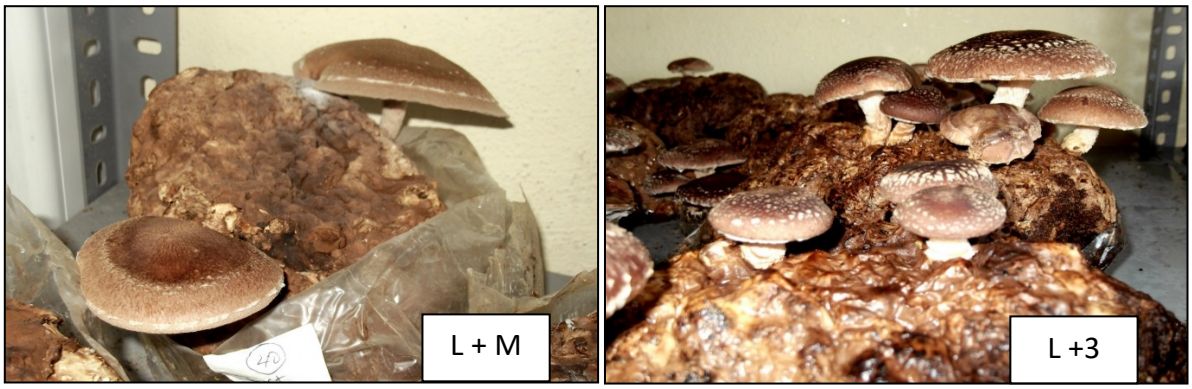
Ortamların içerikleri Tablo 2'de verilmiştir. Linterin karbon miktarı, mantar gelişimi için uygun bulunmuş olup, azot miktarının yüksek olduğu tespit edilmiştir. Yapılan çalışmalarda lentinus edodes mantarının gelişimi için kullandıkları ortamlarda karbon miktarını %45 ile %48 arasında, azot miktarını % 0,44 ile %1,14 arasında olan bir çok ortamı, mantar gelişimi için kullanmışlardır (Rinker, 1991; Özçelik ve Pekşen, 2007; Philippoussis ve ark., 2007). Aşılamanın ardından degredasyon süresine hızına bağlı olarak artma ve azalma gözlenmiştir. Karbon/azot oranı %19 ile %30 arasında olduğu tespit edilmiş olup, linterin C/N oranının kendi başına kullanıldığında oldukça düşük olduğu görülmüştür. C/N oranının uygun seviyelerde olması mantar gelişimi ve verimi açısından oldukça önemli olup, çok düşük olması ve çok yüksek olması mantar kültürasyonu için önem taşımaktadır. Yıldız ve Demir (1998) yaptıkları bir çalışmada, C/N oranının çok yüksek olmasının verim değerlerini düşürdüğünü belirtmişlerdir. Linterin tek başına kullanıldığında protein değerinin(12,98), diğer ortamlara göre oldukça yüksek olduğu saptanmıştır. Kontrol örneği olarak kullanılan meşe talaşı, C/N oranı 37 olarak belirlemişlerdir (Sözbir ve ark., 2014a). % 100 linter kullanılarak ve %75 linter kullanılarak hazırlanan ortamlarda misel gelişimi ve mantar eldesi, C/N oranı düşük olduğu için gelişim sağlanamamıştır. %50 ve %25 linter katılarak hazırlanan ortamlarda, gelişim sağlanmıştır.

L+M ve L+3M ortamlarından elde edilen misel gelişimi ve hasat süreleri, verim ve biyolojik etkinlik oranları Tablo 3'de gösterilmektedir. Sözbir ve ark, (2014a) yaptığı çalışmada kullandıkları genel yetişme ortamı olan meşe talaşı kontrol ortamını, linter ortamlı sonuçlarla karşılaştırmak için kullanılmıştır. Kullanılan ortamlar için 2 hasat dönemi uygulanmıştır.

Tablo 3. *Lentinus edodes* aşılı ortamların misel gelişimi, hasat süresi, verim ve biyolojik etkinlik miktarları

Ortamlar	Misel Gelişimi (Gün)	Hasat Süresi (Gün)	Mantar eldesi (Gün)	Ortalama Verim (g.kg $^{-1}$)	Ortalama B. E. (%)	Toplam Verim (g.kg $^{-1}$)	Toplam B. E. (%)
Meşe(Kontrol)	51,5	89,08	140	32,45	12,73	64,91	25,46
L+M	61	56,22	117	44,28	12,2	88,56	24,41
L+3M	52	67,25	119	44,58	12,97	89,16	25,94

Linterli ortamlarda, kullanılan linter miktarı arttıkça misel gelişimi, meşe ortamına göre daha uzun olmaktadır fakat hasat süreleri linter miktarı arttıkça azalmaktadır. Bunun sonucu olarak linterli ortamlardan daha kısa sürede mantar eldesi mümkün olmaktadır. Bu ortamlardan 2 hasat döneminin ortalamasına bakıldığında, linterli her iki ortamında verim miktarı, meşe ortamına göre daha yüksek olduğu belirlenmiştir. Toplam verim miktarıda daha yüksek bulunmuştur. Biyolojik etkinlik miktarında, kayda değer bir farklılık tespit edilmemiştir. Yapılan bir çalışmada, pirinç kabuğunda 22 gün misel gelişimi, pirinç sapında 39 gün misel gelişimi, şeker kamışında 53 gün misel gelişimi ve hasat süreleri sırasıyla, 39 gün, 41 gün ve 94 gün olduğu tespit edilmiştir(Ramkumar ve ark., 2010). Toplam verim değerleri, yapılan çalışmalarla karşılaştırıldığında pirinç kabuğunda, 220 g.kg $^{-1}$, şeker kamışında 15 g.kg $^{-1}$, fındık kabuğunda 169 g.kg $^{-1}$ olduğunu belirlemişlerdir (Ramkumar ve ark., 2010; Özçelik ve Pekşen, 2007).



Şekil 1. L+M ve L+3M ortamı üzerinde yetiştirilen *Lentinus edodes* mantarı genel görünümü

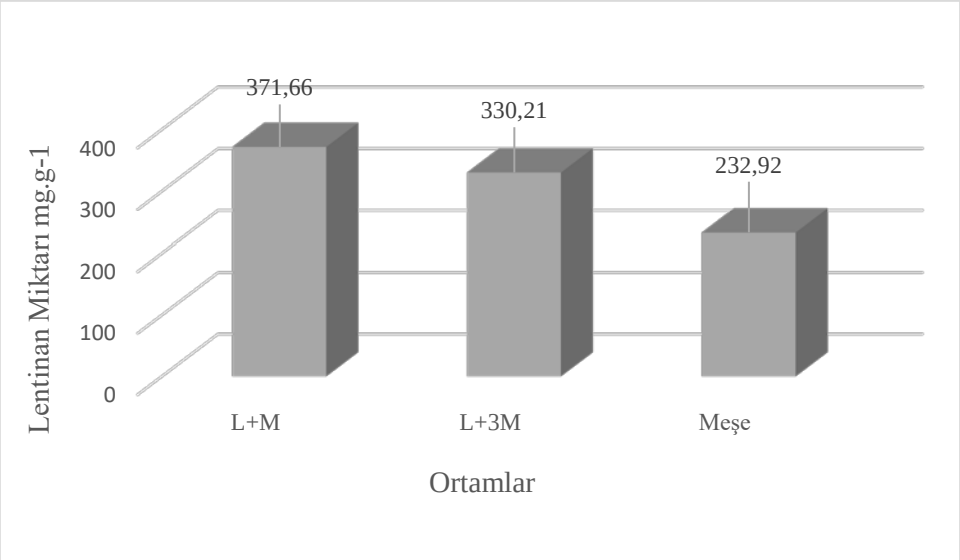
Tablo 4 de *Lentinus edodes* mantarının protein içeriği yüzde miktarları (%) ve morfolojik özellikleri gösterilmektedir. Meşe kontrol örneğinin analizi karşılaştırmadaki doğruluk açısından aynı analize tabi tutulmuştur. Protein miktarı en yüksek L+M ortamında yetiştirilen mantardan elde edilmiştir. Linterli ortamlardan elde edilen mantarın protein miktarı, kontrol ortamına göre daha yüksek bulunmuştur. Mantar ağırlığı, şapka genişliği, kalınlığı ve sertliği, kontrol örneğiyle karşılaştırıldığında, L+M ortamında yetiştirilen mantarlarda oldukça yüksek olduğu tespit edilmiştir. Sap kalınlığının ve kuru madde miktarının en yüksek olduğu mantar, L+3M ortamından elde edildiği belirlenmiştir. Genel olarak linterli ortamlardan elde edilen mantarların morfolojik özellikleri kontrol ortamına göre daha iyi olduğu gözlenmiştir.Yapılan çalışmalarda, protein miktarının %11 ile % 21 arasında değiştiğini yetiştirilen ortamların farklılığına göre elde edilen mantarlardan tespit edildiğini bir çok çalışmada belirtilmektedir(Philippoussis ve ark., 2007; Xiao-Hui ve ark., 2014). Yapılan çalışmalarla karşılaştırıldığında, kullanılan ortamlarda linter miktarı arttıkça elde edilen protein miktarının oldukça yüksek olduğu görülmüştür. Yapılan bir çalışmada, 20 ile 81 g arasında mantar ağırlığı, 41 ile 71 mm arasında sap uzunluğu, 8 ile 17 arasında sap kalınlığı, 16 ile 28 mm arasında şapka genişliği, 9 ile 14 mm arasında şapka kalınlığı, %8 ile %17 arasında kuru madde olduğu belirlemişlerdir (Özçelik ve Pekşen, 2006). Başka bir çalışmada, şapka genişliğini 34 mm ile 60 mm arasında bulmuşlardır(Moonmoon ve ark., 2011). Yapılan çalışmalarla karşılaştırıldığında, linterli ortamlarda yetiştirilen mantarların şapka genişliklerinin oldukça yüksek olduğu, diğer değerlerin ortalama aralıkta olduğu görülmüştür.

Tablo 4. *Lentinus edodes* mantarının protein içeriği yüzde miktarları (%) ve morfolojik özellikleri

Ortamlar	Protein	Mantar ağırlığı (g)	Sap uzunluğu (mm)	Sap kalınlığı (mm)	Şapka genişliği (mm)	Şapka kalınlığı (mm)	Kuru madde (%)	Mantar sertliği (Kg)
Meşe(Kontrol)	18,21	23,41	43,04	8,64	75,1	12,16	18,32	1,59
L+M	29,31	32,86	42,93	9,36	93,22	14,2	12,98	1,66
L+3M	20,19	25,32	42,86	9,54	83,7	12,32	21,32	1,64

Sözbir ve ark. (2014b) Yaptığı çalışmada kontrol örneği olarak kullanılan meşe talaşında yetiştirilen mantarın lentinan miktarı kıyaslamak açısından kullanılmıştır. Şekil 2 incelendiğinde kansere karşı etken madde olan lentinan eldesi kontrol ortamında yetişen mantardan elde edilen lentinan miktarı ile karşılaştırıldığında, ortamlardaki linter miktarı arttıkça, elde edilen mantarın lentinan miktarının da arttığı tespit edilmiştir.Yapılan çalışmalarda, Lentinus edodes mantarını farklı çözücü kullanarak elde edilen lentinan miktarı 877 ml.g-1 (Xu ve ark., 2010) olarak ve başka bir çalışmada 260 ile 824 mg.g-1 arasında değiştiğini belirlemişlerdir (Tomassen ve ark., 2011). Yapılan çalışmalarla karşılaştırıldığında elde edilen lentinanın ortalama değerlerde olduğu gözlemlenmektedir.

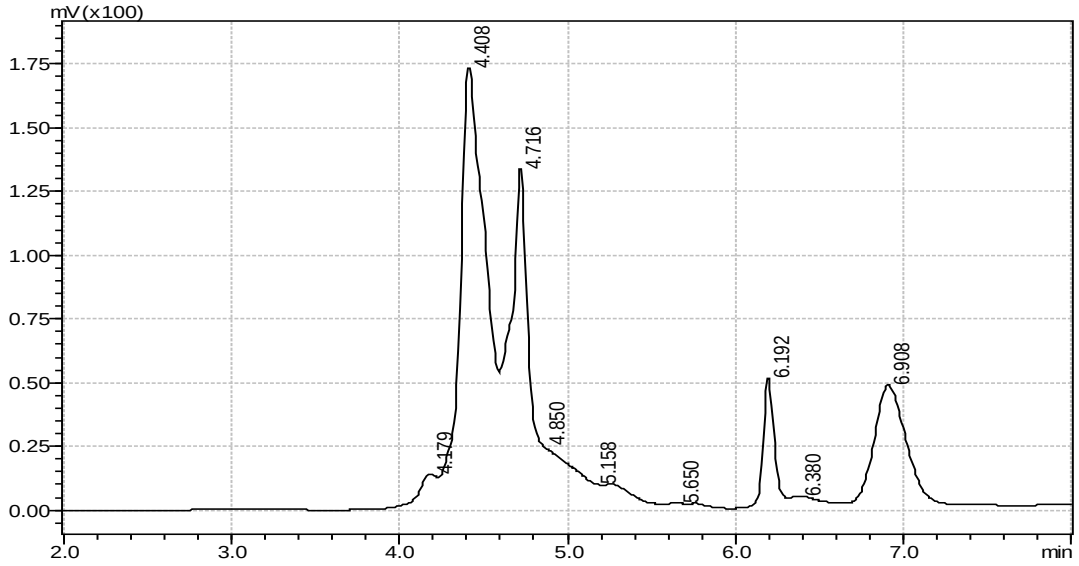
Yapılan çalışmada, linoleik asit miktarının, kontrol örneğinde yetiştirilen mantarla karşılaştırıldığında, linterli ortamlarda yetişen mantarda daha yüksek olduğu, palmitik asit ve oleik asit miktarının daha az olduğu belirlenmiştir .L+M ortamında ise oleik asit görülmemiştir. Yapılan çalışmalarda, *Lentinus edodes* mantarının yağ asidi içeriğinde, , % 11,78 palmitik asit, % 3,28 oleik asit, % 78,59 linoleik asit tespit edildiğini (Carneiro ve ark., 2013), başka bir çalışmada, linoleik asit miktarını % 72,8, palmitik asit miktarını % 14,7, oleik asit miktarını % 3, tetradekanoik asit miktarını % 1,6, stearik asit miktarını % 0,9, miristik asit miktarını % 0,1 olduğunu (Wasser, 2005). Yapılan bu çalışma, yapılan çalışmalardan elde edilen bulgulara yakınlık göstermiştir.



Şekil 2. Farklı ortamlarda yetiştirilen *Lentinus edodes* mantarından elde edilen lentinan miktarları

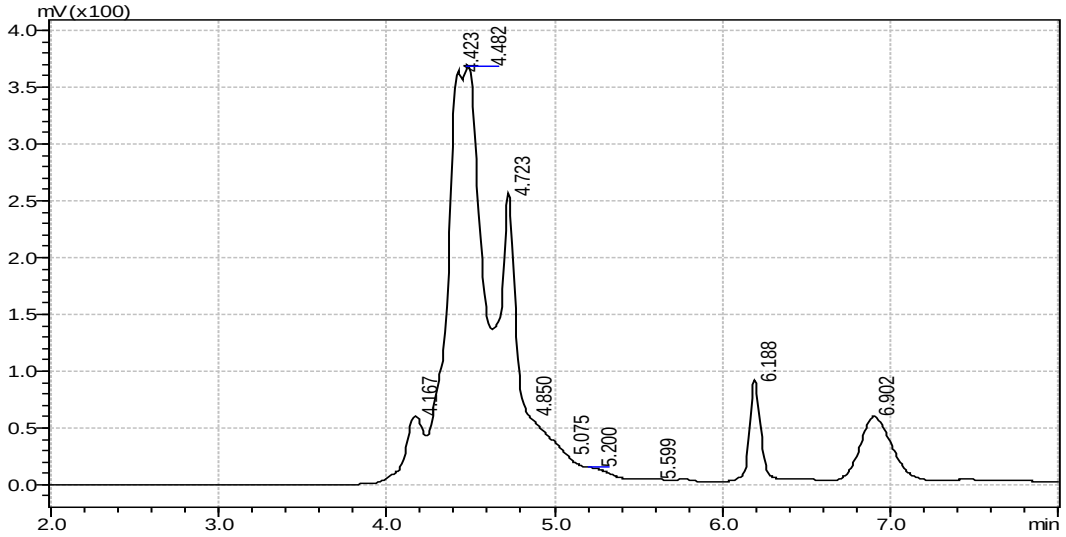
Tablo 5. Meşe ve linter bulunan ortamlardan elde edilen mantarların yağ asidi içerikleri ve yüzde miktarları

Bileşen isimleri	Meşe	L+M	L+3M
Linoleik asit	51,04	66,4	62,8
Palmitik asit	20,1	10,4	15,7
Oleik asit	9,11	nd*	5,47
Kaprilik asit	2,82	nd*	2,11
Pentadekanoik asit	1,92	0,79	1,88
Stearik asit	1,33	1,84	1,55
Araşidik asit	0,23	5,61	nd*
Tridekanoik asit	1,9	nd*	1,29
Miristik asit	0,96	0,25	0,89
Palmitoleik asit	0,51	0,15	nd*
Pentadekanoik asit	0,63	nd*	0,47
Heptadekanoik asit (Toplam)	0,8	0,12	1,07



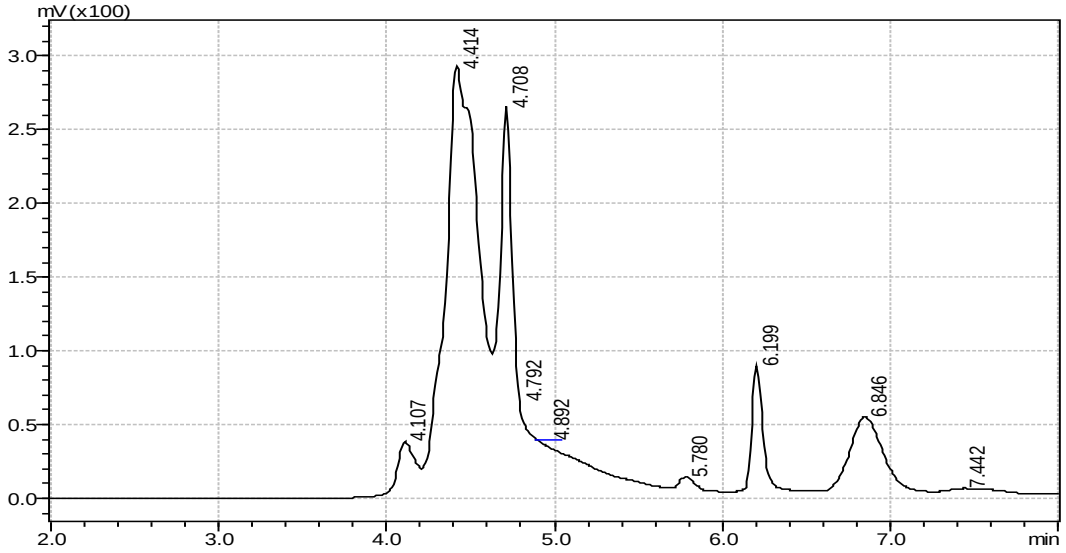
Şekil 3. Meşe ortamı üzerinde yetiştirilen *Lentinus edodes* mantarının flavanoid olmayan fenolik asit içeriği (HPLC kromotogramı)

Şekil 3 incelendiğinde meşe ortamı üzerinde yetiştirilen *Lentinus edodes* mantarından elde edilen kromotograma göre, % 24,09 oranında salisilik asit, % 13,86 oranında fumarik asit bulunduğu tespit edilmiştir.



Şekil 4. L+M ortamı üzerinde yetiştirilen *Lentinus edodes* mantarının flavanoid olmayan fenolik asit içeriği (HPLC kromotogramı)

Şekil 4'e bakıldığında, L+M ortamı üzerinde yetiştirilen *Lentinus edodes* mantarından elde edilen kromotograma göre, % 19,63 oranında salisilik asit, % 7,81 oranında fumarik asit bulunduğu belirlenmiştir



Şekil 5. L+3M ortamı üzerinde yetiştirilen *Lentinus edodes* mantarının flavanoid olmayan fenolik asit içeriği (HPLC kromotogramı)

L+3M ortamı üzerinde yetiştirilen *Lentinus edodes* mantarından elde edilen kromotograma göre, % 18,15 oranında salisilik asit, % 9,34 oranında fumarik asit ve % 1,07 oranında gallik asit bulunduğu saptanmıştır (Şekil 5).

Yapılan çalışmada flavanoid olmayan fenolik asit içeriğinde salisilik asit miktarı en yüksek kontrol örneğinde, fumarik asit miktarının linterli ortamlarda yetişen mantarda kontrole göre daha düşük tespit edildiğine ve L+3M ortamında ilaveten gallik asit bulunduğu tespit edilmiştir. Yapılan bir çalışmada farklı analiz metotları uygulanarak elde edilen shiitake mantarı ekstraktlarının HPLC cihazında flavanoid olmayan fenolik asit analizi yapılmış, sonucunda vanilin ve homogentisik asit (Kim ve ark., 2008) ve hidroksibenzoik asit, vanilik asit ve sinamik asit bulunduğunu belirlemişlerdir (Carneiro ve ark., 2013). Bu çalışmanın sonucu, yapılan çalışmalarla kıyaslandığında, farklı fenolik asitler elde edildiği saptanmıştır. Bu durum, yetiştirme ortamlarının veya ekstraksiyon yönteminin etkisi olduğu düşünülmektedir.

4. Sonuç Ve Öneriler

Ortamların sterilizasyon sonunda pH miktarları hemen hemen aynı bulunup, misel aşılamadan sonra mantar enzimlerinin neden olduğu asitlik etkisiyle pH azaldığı tespit edilmiştir. Hasat sonunda enzim aktivitesi yavaşlayıp, pH da hafif bir artışa sebep olduğu belirlenmiştir. Ortamların karbon/azot oranı, mantar miselinin gelişimi ve ürün eldesi için önemlidir. %100 linter ve %75 linter+ %25 meşe olan ortamlarda uygun oran sağlanamadığı için misel gelişimi görülememiş ve ürün elde edilememiştir.

L+M ve L+3M ortamların misel gelişimi, kontrole göre daha uzun olmasına rağmen hasat süresi daha kısa ve mantar eldesi süresinin daha kısa olduğu tespit edilmiştir. Ortalama verim ve toplam verim, L+M ve L+3M ortamlarında, kontrole göre daha yüksek olduğu bulunmuştur. L+M ortamından elde edilen mantarların protein miktarı, mantar ağırlığı, şapka genişliği ve kalınlığı, mantar sertliği yüksek olduğu belirlenmiştir. En yüksek kuru madde miktarı L+3M ortamından elde edilen mantardan alınmıştır.

Ortamlarda kullanılan linter miktarı arttıkça, üretilen mantarlardan elde edilen lentinan miktarının yüksek olduğu saptanmıştır. linterli ortamlardan elde edilen mantarların yağ asidi içeriklerinde, kontrolle karşılaştırıldığında, L+M ve L+3M ortamından elde edilen mantarlarda en yüksek linoleik asit ve stearik asit içeriği tespit edilmiştir. *Lentinus edodes* mantarının flavanoid olmayan fenolik asit içeriğinde (HPLC kromotogramı), salisilik asit, fumarik asit tüm parametrelerde belirlenmiştir fakat linterli ortamlarda yetiştirilen mantarlarda bu oran daha düşük olduğu belirlenmiştir. Ayrıca L+3M ortamında ilaveten gallik asitte olduğu tespit edilmiştir.

Ülkemizdeki kültürasyonu yok denilecek kadar az olan bu mantarın, sıradan kültür mantarları ile kıyaslandığında daha lezzetli ve tıbbi açıdan değerli olması ayrıca herhangi bir işlem gerektirmeden tüketilmesiyle içerdiği etken maddelerden faydalanılması, ileride ticari olarak varlığının hız kazanmasına neden olacaktır. Yapılan çalışmada yüksek verimli ve iyi kalitede üretilen mantar parametresinin belirlenmesi, kültür mantarı üretimine ve tıbbi mantar üretimine katkı sağlayacaktır

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A COMPARISON STUDY ON LICHENS OF THREE NATIONAL PARKS FROM TURKEY

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ABSTRACT

In this study, species richness of three national parks (NPs) (Altınbeşik Cave, Köprülü Canyon, Termessos) were compared based on by using Jaccard similarity index. On the other hand, lichens of all three national parks were compared also according to Wirth's (2010) ecological indicator values for light, temperature, humidity, pH of substrates and eutrophication. According to the Jaccard similarity test result, the lichen richness similarities of the three near national parks in the Mediterranean region of Turkey were found less than 0.5. Termessos NP and Köprülü Canyon NP are more similar to each other than Altınbeşik Cave NP in terms of lichen species richness. In addition, the lichen diversity of Altınbeşik Cave NP is less and different than other two parks'. This difference may be due to the fact that the park has much narrower altitudinal gradients and a substantial smaller area compared to other two parks. It can be explained by somewhat continental characteristics of Altınbeşik Cave NP. Futhermore, it was found that the indicator varieties of Altınbeşik Cave NP are less than two national parks' in terms of almost all examined factors. Similarly, Köprülü Canyon NP has much more indicator variety than other two parks in terms of almost all examined factors. Further studies are needed to explain the reasons of similarities and dissimilarities of the three national parks according to lichen richness.

Key words: Antalya, biodiversity; Jaccard similarity index, Wirth's indicator values

Türkiye'den Üç Milli Parkın Likenleri Üzerine Bir Karşılaştırma Çalışması

ÖZ

Bu çalışmada, üç milli parkın (MP) (Altınbeşik Mağarası, Köprülü Kanyon, Termessos) tür zenginlikleri Jaccard benzerlik indeksi kullanılarak karşılaştırılmıştır. Ayrıca, üç milli parkın likenleri Wirth (2010)'in ışık, sıcaklık, nem, substrat pH'sı ve ötrofikasyon için belirlediği ekolojik indikatör değerlerine göre karşılaştırılmıştır. Jaccard benzerlik testi sonucuna göre, Türkiye'nin Akdeniz Bölgesi'ndeki üç yakın milli parkın liken zenginliklerinin benzerliği 0,5'ten daha az bulunmuştur. Termessos MP ve Köprülü Kanyon MP Altınbeşik Mağarası MP'dan liken türlerinin zenginliği bakımından birbirlerine daha benzerdirler. Ayrıca, Altınbeşik Mağarası MP'ının liken çeşitliliği diğer iki parktan daha az ve farklıdır. Bu farklılık parkın diğer iki bölgeye göre çok daha dar irtifa gradyanına ve daha küçük yüzölçümüne sahip olmasından kaynaklanmış olabilir. Altınbeşik Mağarası MP'ının bir miktar karasal özelliği ile de açıklanabilir. Ayrıca Altınbeşik Mağarası MP'ının indikatör çeşitliliğinin incelenen hemen hemen tüm faktörler açısından diğer iki milli parkın çeşitliliğinin altında olduğu tespit edilmiştir. Benzer şekilde, Köprülü Kanyon MP hemen hemen tüm faktörler açısından diğer iki parktan çok daha fazla indicator çeşitliliği göstermektedir. Liken zenginliğine göre üç milli parkın benzerlik ve farklılıklarının nedenlerini açıklamak için daha fazla çalışmaya ihtiyaç vardır.

Anahtar kelimeler: Antalya, biyoçeşitlilik; Jaccard benzerlik indeksi, Wirth'in indikatör değerleri

Introduction

Some lichens generally are adapted to extreme conditions and stress situations (Le Devahat et al. 2014). On the other hand, other lichen species are sensitive to even weak changes in their environments. Due to such properties they are bioindicators. Their resistance to extreme conditions and their sensitivity to environmental changes have been subject to numerous investigations (Böttger et al. 2014; De Guevara et al. 2014).

Turkey is known to be extremely rich in terms of Key Biodiversity Areas (Eken et al. 2006). In the period from 1958 to 2019, 44 National Parks (NP) have been declared in the areas with high biological diversity in Turkey. Presence

and/or compositions of lichen species in an area are reliable indicators of various natural and anthropogenic influences. In other words, accurate recordings of lichen diversity in a given area set the basis to monitor any influences in space and time on that area. Therefore, a through inventory on lichens in Turkey needs to be completed, giving priority to protected areas. Antalya has four National Parks, namely, Altınbeşik Cave (Altınbeşik), Köprülü Canyon (Köprülü), Termessos and Olimpos. Lichens of Termessos (Tufan et al. 2005), Köprülü (Ayaşlıgil 1987, Tufan-Çetin & Sümbül 2011) and Altınbeşik (Tufan-Çetin 2019) have previously been studied. The first aim of this study to compare lichen species richness of three NPs based on by using Jaccard similarity index. Jaccard Similarity Index (Sj) is a means in quantifying overall similarity (or dissimilarity) levels among different areas in terms of numbers of similar and different taxa they contain.

Second aim of this study is that lichens of all three national parks were compared also according to Wirth's ecological indicator values. In 1991, Volkmar Wirth was started to grade lichen taxa in Europe for each of some ecological factor (namely light, temperature, humidity, pH of substrates, eutrophication) (Wirth 1991). It was then updated in 2010 (Wirth 2010). These values, ranging from 1 to 9 for each ecological factor were named as ecological indicator values. According to the indicator values of lichens in three national parks, the areas were compared in terms of ecological characteristics that they are indicative.

Materials and Methods

Study areas

Altınbeşik area was declared as NP in 1994; located between 37°01.19' to 37°04.37' N, and 31°35.49' to 31°38.52' E (Figure 1). The NP covers 1156 ha area, where the lowest altitude is 380 m, and the highest 1165 m. It is located in the Mediterranean bioclimate zone with rainy and cool winters and semi-arid summers. According to the ***Emberger*** quotient, the area remains within the very rainy and rainy Mediterranean bioclimate zone. 123 lichen taxa have been recorded in the park (Tufan-Çetin 2019).

Termessos is located on the western ranges of the Taurus Mountains, and was declared as NP in 1970. The park covers 6702 ha area, and it is located between 36º55.24' to 37º02.30' N, and 30º03.12' to 30º31.30' E (Figure 1). The lowest altitude in Termessos is 250 m, and the highest is 1665 m. In an earlier study, 159 lichen taxa have been recorded in the park (Tufan et al. 2005).

Köprülü covers 36616 ha area and is located between 37º07.36' and 37º25.11' N and 31º 03.31' to 31º 14.00' E (Figure 1). The altitudes of the area range from 125 m to 2504 m. The area was declared as National Park in 1973, based on mainly its natural, cultural and recreational values. In earlier studies, 218 lichen taxa have been recorded in the area (Ayaşlıgil 1987, Tufan-Çetin & Sümbül 2011).

Comparison of lichen richness in three national parks by Jaccard Similarity Index

The lichen richness data of three national parks, located in Antalya region, were compared using the Jaccard Similarity Index (Sj). Jaccard Similarity Index (Sj) is a means in quantifying overall similarity (or dissimilarity) levels among different areas in terms of numbers of similar and different taxa they contain (Sneath & Sokal 1973, Isık et al. 2005). For any given pair of study areas (for example X and Y areas), the numbers of common taxa and different taxa are determined from the pooled taxa list for the respective site pairs (Table 1). Based on these data, a S_j value for each area pair is calculated by the equation below:

$$Sj = \frac{a}{a + b + c}$$

Where

Sj = Jaccard Similarity Index,

a = number of common taxa present in both site X and site Y,

b = number of taxa present in site X; but not in Y,

c = number of taxa present in site Y; but not in X.

Using Sj values, a matrix was prepared and the results were transferred to a phenogram according to UPGMA method (Sneath & Sokal 1973).

Comparison of lichen richness in three national parks by Wirth's indicator values

In addition, lichen species composition of the respective areas based on ecological indicator values as defined by Wirth (2010) has been compared. For five ecological factors (light, temperature, humidity, pH of substrates, eutrophication), Wirth (2010) defined indicator values to lichen species that run from 1 to 9. "1" is the lowest for each factor. Availability distributions of Wirth's ecological indicator varieties for three NPs were determined. These distrubitions of three parks were compared. Comparisons were made to epiphytic and non-epiphytic species separately. Non-epiphytic species include those lichens grown on rocks, soil, raw humus and moss.

Results

Comparison of lichen richness in three national parks by Jaccard Similarity Index

For any given pair of study areas (i.e., XY, XZ and YZ), the numbers of common taxa and different (absent) taxa are listed in Table 1. For example, out of the 123 taxa present in Altınbeşik, 99 are also present and 24 are absent in Köprülü. Based on the data in Table 1, Jaccard Similarity Index (Sj) values were calculated and presented in Table 2. Finally, using Sj values, in Table 2, a phenogram was presented according to UPGMA method (Sneath & Sokal 1973).

When the data of three NPs were compared according to Jaccard Similarity Index, the lichen richness similarities were found less than 0.5. Futhermore, it was found that Termessos and Köprülü's taxa composition were more similar to each other than they were to Altınbeşik (Figure 2). The difference of Altınbeşik NP from the other two may be due to various geographic and altitutinal characters of Altınbeşik NP. For example Altınbeşik has the smallest area (1156 ha) lowest mean altitude (772 m), and narrowest altitutinal range (from 380 to 1165 m) among the three NPs. All these factors might be the causes for the lowest taxa number and less number of common species present both in Termessos and Köprülü NPs.

Comparison of lichen richness in three national parks by Wirth's indicator values

Wirth (2010) graded 504 lichen taxa in Europe for each of some ecological factor (namely light, temperature, humidity, pH of substrates, eutrophication). These values, ranging from 1 to 9 for each ecological factor were named as ecological indicator values. Availability distributions of these ecological indicator varieties for three NPs were determined and compared for epiphytic species and non-epiphytic species separately.

In terms of light factor, epiphytic (E) lichen species (Figure 3a) generally appear to be found in half-shaded to half-lighted conditions (values 5 to 7) whereas non-epiphytic (NE) species (Figure 3b) were distributed half-shaded to full-lighted areas (values 6 to 9) in all of the three NPs. In Köprülü and Termessos different than Altınbeşik, "shade and half-shade epiphytic lichens" (value 4) and "light epiphytic lichens" (value 8) were found. Most E species in are found around light class 7, which is considered as "half-light" lichens by Wirth (2010). However, NE species are found mostly on classes 8 and 9, "full-light". In addition, there are "half-shade NE lichens" (value 5) in Termessos unlike the other two national parks.

As to of temperature factor, E species are found mostly in areas with indicator value 5, which corresponds to the range from medium cool to medium warm (Wirth 2010). Frequency values of E species shows a bell shaped distribution, ranging from 4 to 7 around mode 5 (Figure 3c). Király et al. (2013) reported that high ranges of temperature and light amount and heterogeneity increase the lichen species diversity. In that respect, Altınbeşik (which has the lowest numbers of taxa among the NPs), has no E species in light indicator values 4, 8 (Figure 3a), and also not in temperature indicator value 3 (Figure 3c). NE species, however, distributed mostly in values from 4 to 6, followed by lower frequencies in values from 7 to 9 (Fig. 3d). Lichen taxa that require more light also appear to require higher temperature (Figure 3b, and Figure 3d). The trends of relative distribution among the indicator values were more or less similar for all the three NPs.

As to substrate pH level, E species appear to be demanding moderately asidic and/or neutral substrate (value from 5 to 7) (Figure 3e) than NE species, most of which appear on relatively alkaline substrate with indicator values 8 and 9 (Figure 3f), which corresponds to pH level 7.0 and above (Wirth 2010). In addition, it is seen that E lichens preferring very acidic bark (2) are not in Altinbesik and the species preferring neutral bark (8) are found only in Koprulu. Furthermore, for non-epiphytic lichens, it is seen that Köprülü and Termessos have a similar and much wider distribution than Altınbeşik according to pH of substrates.

In terms of humidity factor, both E and NE species have the highest frequency (above 40% in all the three NPs) in indicator value 3, which means most part of the all three national parks take low precipitation but often moistly. Likewise,

relatively higher frequency of both E and NE lichens occur in class 5. It means another big parts of all three NPs take precipitation more than 700 mm (Figure 3g and Figure 3h).

According to Wirth (2010) eutrophication values are defined as 1 being no eutrophication and 9 being very strong eutrophication. Most of the E species are found on areas with values between from 4 to 6 (weak to evident eutrophication) (Figure 3i). However, NE species more or less equally distributed among the values ranging from 2 to 8, with the exception of value 6 (Figure 3j). This trend was similar in all three NPs. In addition, about 5% NE and E lichens appear to grow under heavy eutrophication level (i.e., class 9).

Table 1. Numbers of total, common (present in both) and different (absent) taxa in site pairs in three National Parks (NP) (Bold numbers indicate total taxa present in a given NP)

National Park name	NP code	Altınbeşik, X		Koprulu, Y		Termessos, Z	
		Present	Absent	Present	Absent	Present	Absent
Altınbeşik	**X**	**123**	0	99	24	78	45
Koprulu	**Y**	99	119	**218**	0	111	107
Termessos	**Z**	78	81	111	48	**159**	0

Table 2. Jaccard Similarity Index (Sj) for site pairs in the study ("0" indicates complete dissimilarity and "1.000" full similarity).

National Park name	Altınbeşik	Koprulu	Termessos
Altınbeşik	1.000		
Koprulu	0.409	1.000	
Termessos	0.382	0.417	1.000

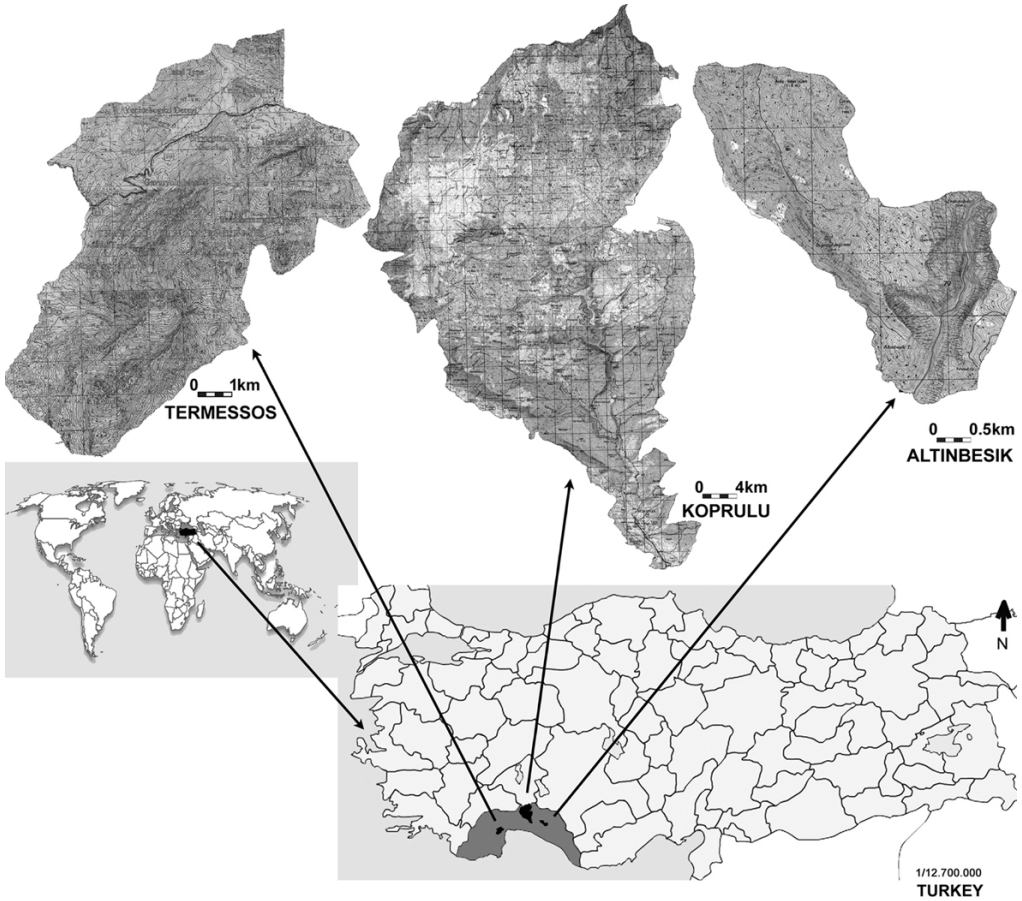

Figure 1. Maps of Altinbesik Cave, Koprulu Canyon and Termessos National Parks.

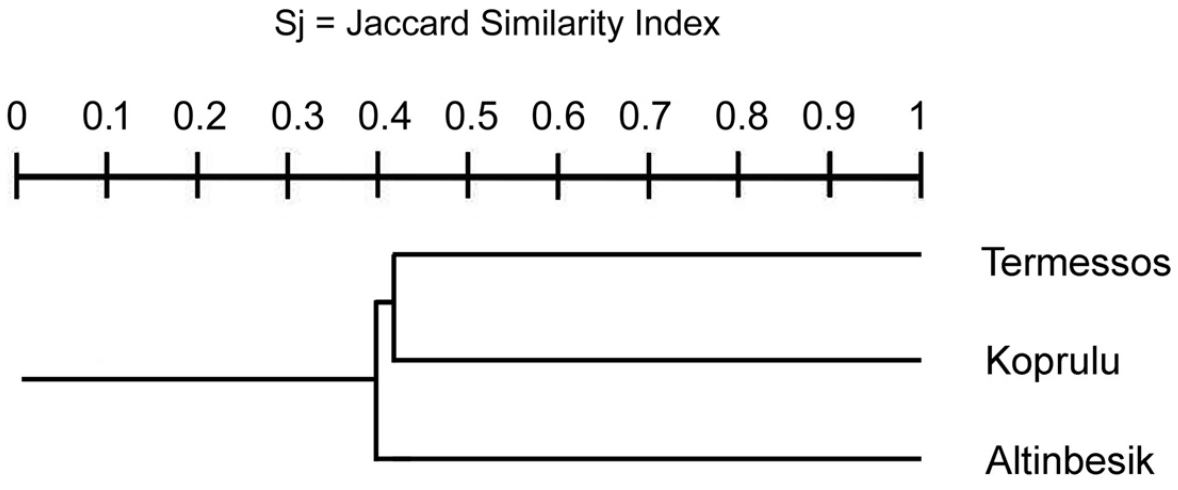

Figure 2. Similarity phenogram for lichen diversity of three national parks.

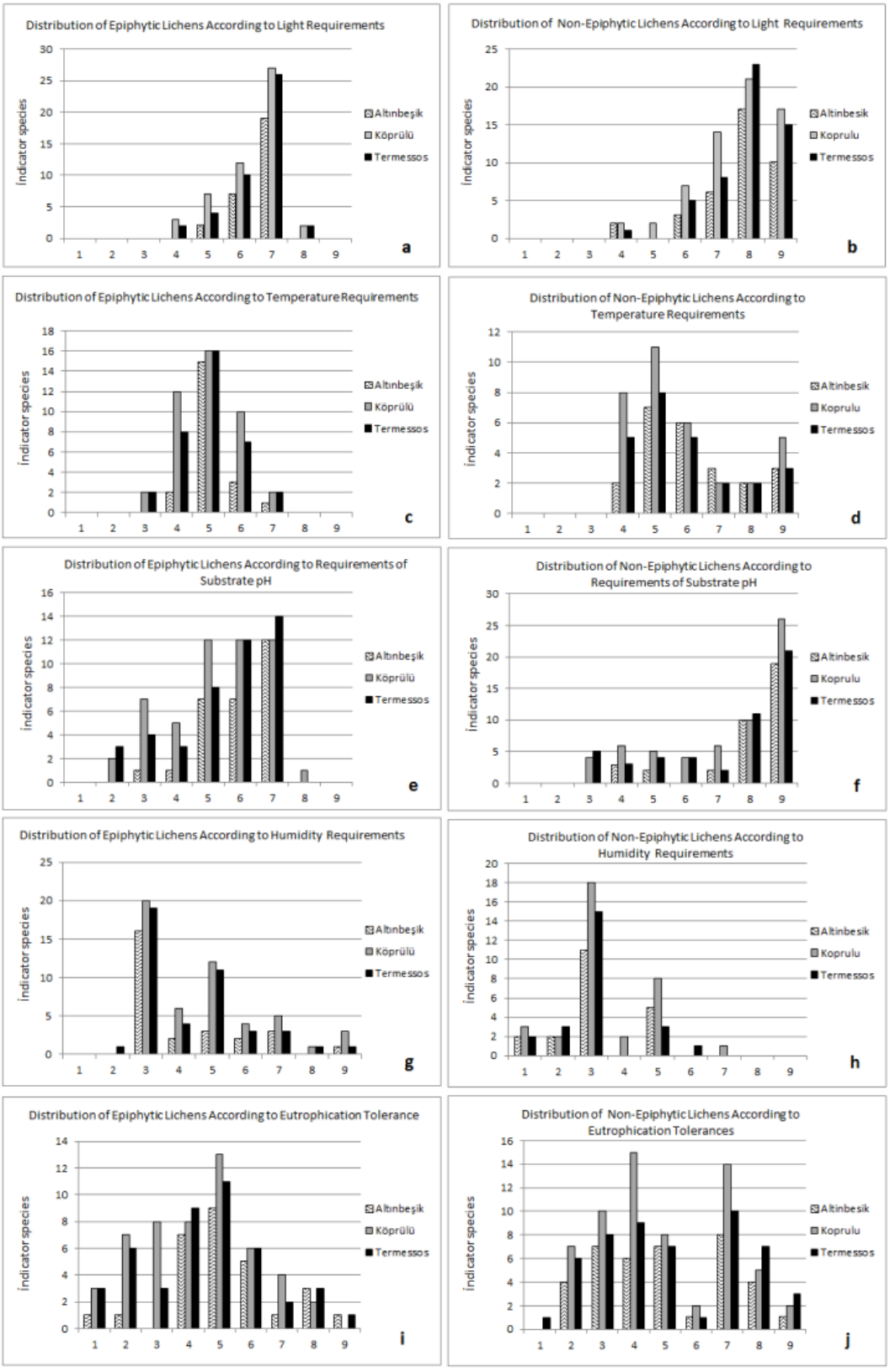

Figure 3. Distribution of epiphytic (E) and non-epiphytic (NE) lichen taxa depending on severity of ecological factors (**Light**: a, b; **Temperature**: c, d; **Substrate pH**: e, f; **Humidity**: g, h; **Eutrophication**: i, j (indicator values run from 1 to 9, 1 being the lightest for each factor).

Discussion

Generally, diversity of organisms increases with increasing sizes of areas as the area-species relationships dictates (Rosenzweig 1995, Drakare et al. 2006). Following this ecological principle, the lowest number of lichen taxa (123) was observed in Altınbeşik, the smallest NP (1156 ha). Altınbeşik NP. There were higher numbers of lichen taxa (number) represent Köprülü NP, which has the largest area (36616 ha) among the three NPs. Both the larger size and landscape, edaphic and climatic diversity lead to higher number of species in larger areas (Rosenzweig 1995, Drakare et al. 2006).

Species diversity and composition of epiphytic lichens correlate significantly with tree composition and elevation of a given area (Frisch et al. 2015). Higher lichen taxa diversity and higher number of vascular plants from different phytogeographic elements in Köprülü NP are in agreement with the study of Frisch et al. (2015).

Most of epiphytic (E) lichens of all three NPs are categorized as half-light (Figure 3a). Malaspina (2014) reported that shading was necessary for prolonging the vitality of E lichens. In addition, deep-shade requiring lichens were not found in any of three NPs (values 1-3), which is the case in many studies (Karabulut et al. 2004, Wirth 2010, Košuthová & Šibík 2013) about lichen diversity from different regions of the World (Figure 3a; Figure 3b). This is because heavy shade and long dark period have important negative influences on photosynthesis of lichens (Pisani et al. 2007).

Because Altınbeşik NP is located futher away from the coast than the other two NPs, it has relatively strong seasonality of temperature such as cold winters, hot summers and low precipitation. That may be the reason why frequency of E species reaches maximum value in temperature class 5, which corresponds to medium cool-medium warm (Figure 3g) according to Wirth (2010). Similarly, frequency of E species reaches the highest value in humidity class 3 (i.e., tolerant to low precipitation) (Figure 3g). This finding shows that Altınbeşik have more continental characters than other parks and frequency of continental indicators was more than compared areas.

In terms of pH level, *L. vulpina* seems to prefer acidic substrates (indicator value 2, pH 3.4 to 4). This species had been found on very acidic barks of trees like *Pinus brutia*, *P. nigra* and *Cedrus libani*, both in Termessos and Köprülü NPs. Although, the same tree species also present in Altınbeşik, *L. vulpina* taxon was not observed either on these and other tree species in Altınbeşik (Figure 3e). Because this species belongs to high mountains and there is not enough altitudes in Altinbeşik to meet height requirement of *L. vulpina*. In studies, pH of bark surfaces were noted as one of the most important factors affecting the community structure of corticolous organisms (Kuusinen 1996, Larsen et al. 2007). However, a study of Spier et al. (2010) showed that types of tree species (tree age, bark's water holding capacity, roughness and other chemical properties) is a much better predictor for the epiphytic vegetation than pH of bark alone. In this study, it is seen that only ph of substrate is not the most effective factor in lichen variation.

Most of the NE species (more than 40%) are found on alkaline substrate (indicator values 8 and 9) in all three NPs (Figure 3f). This arises mainly from the fact that most of the NE species are found on calceorous rocks (CR) (Table 2).

Nitrogen pollution appears to be the main causes for development of eutrophic lichens. For example, the frequency of high nitrophytic lichen species increased with increasing human disturbance in forest vegetation (Karabulut et al. 2004, Temina et al. 2009). Also Jovan et al. (2012) reported that eutrophic lichen species distributions were induced by the combined effect of multiple nitrogen pollutants. The increase of nitrogen level lowers the biochemical diversity of lichens which leads to decrease in lichen diversity (Hauck 2011). In this study, the results indicate that there are lichens living no-eutrophication areas in three parks. In addition very strong eutrophication lichens are available in three parks caused by nitrogen pollution or human destruction. For example, *Protoparmeliopsis muralis* (an NE taxon, grade 9 with high tolerance) was found in all the three NPs. Another NE (grade 9) taxa, *Lecania inundata*, was recorded only in Termessos NP. Similarly, *Phaeophyscia orbicularis* (an E taxon, grade 9) are present in all three NPs and other E (grade 9) taxa, *Flavoplaca citrina*, was recorded only in Termessos NP. The data indicate that there are five eutrophication sensitive (grade 1) species, namely *Degelia plumbea, Letharia vulpina, Parmeliella triptophylla, Phylctis agelaea* (all E taxa) and *Cladonia cervicornis* (only NE taxa) in the study. Of these *D. plumbea* was recorded in all three NPs. *L. vulpina* is found in Köprülü NP and Termessos NP. *P. triptophylla* only in Köprülü, and *P. agelaea* and *C. cervicornis* (NE taxon) were recorded only from Termessos NP.

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HYPOGEOUS *PEZIZALES* OF TURKEY AND THEIR DISTRIBUTIONS

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ABSTRACT

Depending on the available literature, a list of 40 hypogeous or semi-hypogeous *Pezizales* species were compiled to exist in Turkey. The taxa are distributed in the families *Helvellaceae, Pezizaceae, Pyronemataceae* and *Tuberaceae.* Among the compiled taxa, *Sarcosphaera coronaria* was found to have widest distribution while 15 of them have been reported from only one locality.

Key words: Ascomycetes, biodiversity, hypogeous fungi, Turkey

Introduction

Macrofungi are the group of fungi with fruiting bodies that can be seen by naked eye. Those macrofungi that produce their fruit-bodies partially or completely embedded in soil are known as hypogeous fungi.

According to the current checklists (Sesli and Denchev, 2014; Solak et al., 2015) and the latest contributions about 2700 macrofungi taxa have been determined in Turkey, and almost 90 of them can be regarded as hypogeous or semi-hypogeous. *Pezizales* is an operculate discomycete group within the phylum Ascomycota and contains many hypogeous species including the truffles.

In this study we made a revise on the hypogeous *Pezizales* of Turkey, and aim to make a contribution to the mycobiota of Turkey by organizing the accumulated data on hypogeous macromycetes growing in Turkey.

Materials and methods

The studies on Turkish macromycetes including the members of hypogeous *Pezizales* were traced and a list of the hypogeous taxa belonging to the order *Pezizales* were prepared together with their distribution localities. The list was also cross-checked with the current checklists and latest contributions. During preparation of the list, only the taxa presented in a peer reviewed article or a full text conference paper were considered, and those presented in other conference papers, graduate theses or project reports were not included in the list.

Results

Ascomycota Caval.-Sm.

Pezizales J.Schröt.

Helvellaceae Fr.

1. ***Balsamia vulgaris*** Vittad.: Muğla (Allı and Doğan, 2019).
2. ***Barssia gunerii*** H.H. Doğan, Bozok & Taşkın: Osmaniye (Doğan et al., 2018).
3. ***Barssia hellenica*** Kaounas, Agnello, P. Alvarado & Slavova: Gaziantep (Uzun et al., 2018).

Pezizaceae Dumort.

4. ***Hydnobolites cerebriformis*** Tul. & C. Tul.: Rize, Trabzon (Uzun and Kaya, 2018).
5. ***Pachyphlodes citrina*** (Berk. & Broome) Doweld: Rize, Trabzon (Uzun and Kaya, 2018).
6. ***Pachyphlodes conglomerata*** (Berk. & Broome) Doweld: Giresun, Trabzon (Uzun and Kaya, 2018).
7. ***Sarcosphaera coronaria*** (Jacq.) J. Schröt.: Adana (Işıloğlu and Öder, 1995b); Adıyaman (Kaya et al., 2004; Kaya, 2009a); Ankara (Akata et al., 2009; Öztürk et al., 2017); Antalya (Gezer, 2000; Öztürk et al., 2003; Solak et al., 2014); Aydın (Allı et al., 2007); Balıkesir (Altuntaş et al., 2017); Bolu (Afyon and Konuk, 2001; Yağız et al., 2006a); Bursa (Solak and Gücin, 1992); Denizli (Köse et al., 2006; Gezer et al., 2007a,b, 2008, 2011a; Türkoğlu et al., 2007a; Türkoğlu, 2008); Erzurum (Demirel et al., 2003, 2004); Gaziantep (Kaya et al., 2014; Uzun et al., 2015); Hatay (Güngör et al., 2016a); İstanbul (Lohwag, 1957; Selik, 1964; Akata, 2017); İzmir (Solak et al., 1999); Kahramanmaraş (Kaya,

2006, 2009b; Kaya et al., 2009); Karaman (Öztürk et al., 2001); Kastamonu (Demirel, 1998; Yağız et al., 2006b; Akata et al., 2010); Kayseri (Kaşık et al., 2003; Türkoğlu and Gezer, 2006); Konya (Afyon, 1996b, 2000; Öztürk et al., 2000; Aktaş et al., 2003; Alkan et al., 2010); Kütahya (Allı et al., 2017); Manisa (Gücin and Öner, 1982); Mersin (Doğan et al., 2010, 2012; Güngör et al., 2015); Muğla (Güngör et al., 2016b); Niğde (Kaşık et al., 2001; Öztürk et al., 1997); Osmaniye (Solak et al., 2012); Şanlıurfa (Kaya, 2015); Tokat (Yıldız et al., 2019); Uşak (Türkoğlu et al., 2008); Yozgat (Türkekul and Işık, 2016).

8. ***Terfezia albida*** Ant. Rodr., Mohedano & Bordallo: Karaman (Uzun et al., 2016).
9. ***Terfezia arenaria*** (Moris) Trappe: Aydın (Türkoğlu et al., 2015); Isparta (Afyon, 1996a); Konya (Öder, 1988; Kaşık et al., 1998); Malatya (Işıloğlu and Öder, 1995a).
10. ***Terfezia boudieri*** Chatin: Batman (Demir et al., 2007); Diyarbakır (Yıldız and Ertekin, 1997); Elazığ (Gücin, 1990); Elazığ/Malatya (Akyüz et al., 2016); Karaman (Doğan and Öztürk, 2006); Niğde (Kaşık et al., 2001); Şanlıurfa (Kaya, 2015); Uşak (Türkoğlu and Yağız, 2012).
11. ***Terfezia cistophila*** Ant. Rodr., Bordallo, Kaounas & A. Morte: Trabzon (Uzun and Kaya, 2019).
12. ***Terfezia claveryi*** Chatin: Adana (Doğan and Kurt, 2016); Aksaray, Denizli, Diyarbakır, Karaman, Konya, Şanlıurfa, Yozgat (Türkoğlu et al., 2015); Elazığ/Malatya (Akyüz et al., 2016).
13. ***Terfezia leptoderma*** Tul. & C. Tul.: Denizli (Türkoğlu and Castellano, 2014); Uşak (Castellano and Türkoğlu, 2012; Türkoğlu and Castellano, 2014).
14. ***Terfezia olbiensis*** Tul. & C.Tul.: Konya, Nevşehir, Uşak (Türkoğlu and Castellano, 2014); Elazığ/Malatya (Akyüz et al., 2016); Gaziantep (Uzun et al., 2015).
15. ***Tirmania pinoyi*** (Maire) Malençon: İzmir (Yılmaz Ersel and Solak, 2004).

Pyronemataceae Corda

16. ***Genea hispidula*** Berk. ex Tul. & C. Tul.: Trabzon (Uzun and Kaya, 2019).
17. ***Genea klotzschii*** Berk. & Broome: Samsun (Türkoğlu and Castellano, 2014).
18. ***Genea sphaerica*** Tul. & C. Tul.: İzmir (Türkoğlu et al., 2015).
19. ***Genea verrucosa*** Vittad.: Muğla (Türkoğlu and Castellano, 2014).
20. ***Geopora arenicola*** (Lév.) Kers: Adana (Doğan and Kurt, 2016); Adıyaman (Kaya, 2009a,c); Ankara (Öztürk et al., 2017; Akata et al., 2019); Aydın (Allı et al., 2007); Bingöl (Uzun et al., 2009); Diyarbakır (Acar et al., 2015); Elazığ (Gücin, 1990); Gaziantep (Kaya et al., 2012, 2014; Uzun et al., 2015); Iğdır (Uzun, 2010); Kahramanmaraş (Kaya, 2009b); Karaman (Öztürk et al., 2001; Doğan and Öztürk, 2006); Konya (Afyon, 1996b); Malatya (Işıloğlu, 1997); Manisa (Gücin and Öner, 1982); Şanlıurfa (Kaya, 2015); Van (Demirel et al., 2015).
21. ***Geopora arenosa*** (Fuckel) S. Ahmad: Adıyaman (Kaya et al., 2004); Aksaray (Türkoğlu et al., 2007b); Antalya (Solak et al., 2014); Aydın (Allı et al., 2007); Balıkesir (Şen et al., 2014); Denizli (Türkoğlu, 2008); Kahramanmaraş (Kaya, 2006); Kayseri (Kaşık et al., 2002, 2003).
22. ***Geopora cooperi*** Harkn.: Bolu, Burdur, Denizli, Muğla (Türkoğlu et al., 2015); İzmir (Solak et al., 2003)
23. ***Geopora sepulta*** (Fr.) Korf & Burds.: Van (Demirel et al., 2015).
24. ***Geopora sumneriana*** (Cooke) M. Torre: Adana (Doğan and Kurt, 2016); Adıyaman (Kaya, 2009a); Ankara (Akata et al., 2019); Balıkesir (Solak et al., 2002); Bingöl (Uzun et al., 2009); Çankırı (Öztürk et al., 2010); Denizli (Köse et al., 2006; Gezer et al., 2011b); Gaziantep (Kaya, 2009d; Uzun et al., 2015); Kahramanmaraş (Kaya, 2006; 2009b); Kayseri (Kaşık et al., 2003); Konya (Aktaş et al., 2003; Kaşık et al., 2010); Kütahya (Allı et al., 2017); Mersin (Doğan et al., 2007, 2010, 2012); Nevşehir (Doğan and Türkoğlu, 2006); Osmaniye (Solak et al., 2012); Tokat (Türkekul and Sesli, 2003); Uşak (Türkoğlu et al., 2008); Van (Demirel et al., 2015); Yozgat (Türkekul and Işık, 2016).
25. ***Hydnocystis piligera*** Tul.: Aydın (Kaygusuz et al., 2018).
26. ***Picoa juniperi*** Vittad.: Afyon, Antalya, Denizli, Elazığ, Konya, Nevşehir (Türkoğlu and Castellano, 2014); Elazığ/Malatya (Akyüz et al., 2016); Uşak (Türkoğlu and Yağız, 2012); Kayseri (Türkoğlu et al., 2015).
27. ***Picoa lefebvrei*** (Pat.) Maire: Elazığ, Şanlıurfa (Gücin et al., 2010); Aksaray, Denizli, Konya (Türkoğlu et al., 2015); Elazığ/Malatya (Akyüz et al., 2016).
28. ***Stephensia bombycina*** (Vittad.) Tul. & C.Tul.: Samsun (Türkoğlu and Castellano, 2014).

Tuberaceae Dumort.

29. ***Choiromyces meandriformis*** Vittad.: Bolu, Samsun, Uşak (Türkoğlu and Castellano, 2014).

30. ***Reddellomyces parvulosporus*** (G.W. Beaton & Malajczuk) Trappe, Castellano & Malajczuk: Muğla (Ünal et al., 2016).
31. ***Reddellomyces westraliensis*** (G.W. Beaton & Malajczuk) Trappe, Castellano & Malajczuk: Muğla (Ünal et al., 2016).
32. ***Tuber aestivum*** (Wulfen) Spreng.: Antalya, Artvin, Bolu, Burdur, Denizli, Hatay, İstanbul, İzmir, Kırklareli, Muğla, Ordu, Osmaniye (Türkoğlu et al., 2015); Konya (Alkan et al., 2018).
33. ***Tuber borchii*** Vittad.: Kahramanmaraş (Kaya, 2009b); Aydın, Muğla, Samsun, Tekirdağ (Elliot et al., 2016).
34. ***Tuber brumale*** Vittad.: Niğde (Öztürk et al., 1997); Osmaniye, Samsun (Türkoğlu and Castellano, 2014).
35. ***Tuber excavatum*** Vittad.: Denizli (Türkoğlu and Castellano, 2014); Trabzon (Uzun and Yakar, 2018).
36. ***Tuber ferrugineum*** Vittad.: Antalya, Aydın, Denizli, Muğla (Elliot et al., 2016).
37. ***Tuber mesentericum*** Vittad.: Denizli (Castellano and Türkoğlu, 2012; Türkoğlu and Castellano, 2014).
38. ***Tuber nitidum*** Vittad.: Burdur (Türkoğlu et al., 2015); Denizli (Castellano and Türkoğlu, 2012); Osmaniye (Türkoğlu and Castellano, 2014).
39. ***Tuber puberulum*** Berk. & Broome: Denizli, Muğla, Aydın, Osmaniye (Elliot et al., 2016); Artvin, Trabzon (Uzun and Yakar, 2018).
40. ***Tuber rufum*** Pollini: Antalya, Denizli, Kastamonu, Konya, Muğla (Türkoğlu and Castellano, 2014)

Discussions

As a result of this study, 40 hypogeous and semi-hypogeous *Pezizales* taxa, belonging to 15 genera and 4 families have been determined to exist in Turkey. Table 1 shows the distribution of Turkish hypogeous *Pezizales* taxa to the families and genera.

Nineteen (*Balsamia vulgaris, Barssia gunerii, B. hellenica, Genea hispidula, G. klotzschii, G. sphaerica, Genea verrucosa, Geopora sepulta, Hydnobolites cerebriformis, Hydnocystis piligera, Pachyphlodes citrina, P. conglomerata, Reddellomyces parvulosporus, R. westraliensis, Stephensia bombycina, Terfezia albida, T. cistophila, Tirmania pinoyi, Tuber rufum*) of the compiled 40 taxa were reported from Turkey only once, and except *Hydnobolites cerebriformis, Pachyphlodes citrina, P. conglomerata* and *Tuber rufum*, they have been reported from only one locality/province. Six of them (*Hydnobolites cerebriformis, Pachyphlodes citrina, P. conglomerata Terfezia leptoderma, Tuber brumale* and *Tuber excavatum*) have been reported from 2 provinces, two of them from (C*hoiromyces meandriformis, Tuber nitidum*) 3 provinces, two of them from (*Terfezia olbiensis, Tuber ferrugineum*) 4 provinces, and twelve of them from 5 or more provinces. On the contrary, the most common taxa in Turkey are *Sarcosphaera coronaria* (29 provinces), *Geopora sumneriana* (19 provinces) and *Tuber aestivum* (14 provinces) respectively.

Table 1. Distribution of the compiled Turkish hypogeous Pezizales taxa to the families and genera

Family name	**Genus name**	**# of taxa**
Helvellaceae	*Balsamia* Vittad.	1
	Barssia Gilkey	2
Pezizaceae	*Hydnobolites* Tul. & C. Tul.	1
	Pachyphlodes Zobel	2
	Sarcosphaera Auersw.	1
	Terfezia (Tul. & C. Tul.) Tul. & C. Tul.	7
	Tirmania Chatin	1
Pyronemataceae	*Genea* Vittad.	4
	Geopora Harkn.	5
	Hydnocystis Tul. & C. Tul.	1
	Picoa Vittad.	2
	Stephensia Tul. & C. Tul.	1
Tuberaceae	*Choiromyces* Vittad.	1
	Reddellomyces Trappe, Castellano & Malajczuk	2
	Tuber P. Micheli ex F.H. Wigg.	9

Most of the compiled hypogeous *Pezizales* are regarded as edible especially the members of the genera *Terfezia* and *Tuber*. They are also the two genera with economically important taxa.

Among the existing hypogeous *Pezizales, Balsamia vulgaris* and *Choiromyces meandriformis* are currently regarded as rare, threatened or endangered.

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HASTA BİNA SENDROMU VE MİKROORGANİZMALARIN ETKİSİ

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Giriş

Her ne kadar hava kirliliği ve hava kalitesi denilince dış ortam aklımıza gelse de, modern binaların çoğalmasıyla birlikte, hava kalitesinin azalması ve hava kirliliğinin artması, bina içerisinde de meydana gelmektedir. Zamanlarının yarısından çoğunu insanlar kapalı ortamlarda oturma, çalışma, eğitim alma, eğlenme, ibadet etme, yemek yeme, dinlenme için geçirirler. Bu yüzden insanlar için, içinde bulundukları binalar çok önemli bir çevredir. Barınak en temel insan gereksinimlerinden birisidir (Güler ve Çobanoğlu, 1994).

Binanın yapı özellikleri, kullanılan malzeme çeşidi ve kalitesi, mimari tarzı doğrudan insan sağlığını etkilemektedir. Hızla artan nüfusa karşılık vermek isteyen inşaat sektörü; doğal malzeme, doğru planlama ve kaliteli yapım süreçlerini takip etmeksizin konut ve binalar üretmiştir. Son yıllarda, inşaat ve dekorasyon malzemelerinde, mobilyalarda ciddi, radikal değişiklikler meydana gelmiştir. Örneğin doğal ahşabın yerini preslenmiş ahşap ve fiber bazlı malzemeler almaya başlamıştır. Ev ve ofislere duvardan duvara halılar döşenmiş, içlerinde bol miktarda kimyasal yapışkanların olduğu sentetik malzemeler kullanılmıştır. Heybetli, etkileyici ve gösterişli binalar sağlıksız ve olumsuz yaşam tarzı göstergeleri olarak görülebilmekte ve bir nevi hastalık olarak ele alınabilmektedir (Zeybek, 2014). Bunun sonucunda ise, bina ile ilişkili pek çok olası semptomlar ve klinik hastalıklar ortaya çıkmaktadır. Bu semptomlardan biri Hasta Bina Sendromudur.

Hasta Bina Sendromu (HBS); binada yaşayan ya da çalışan bireylerin bina içerisinde vakit geçirmeleriyle görülen, ancak sebepleri büyük ölçüde tam olarak bilinmeyen sağlık sorunlarını tanımlamak için kullanılmaktadır. HBS 1970'lerden itibaren artan bir sıklıkta bildirilmeye başlanmıştır (Kubo ve Ark. 2006). Başlıca belirtileri göz, burun, boğaz ve cilt tahrişi, baş ağrısı, uyuşukluk, sinirlilik ve konsantre olma zorluğudur (Raw ve Goldman 1996).

Hasta Bina Sendromunun Sebepleri (Jönsson, 2000).

1-Mikroorganizma ve alerjenler
2-Yanma sonucu oluşanlar (CO_2, CO, SO_2, NO, partikül maddeler)
3-Formaldehit ve uçucu organik bileşikler
4-Asbest
5-Sigara dumanı
6-Radon'dur.

Küfler başta olmak üzere bakteriler, polenler, virüsler HBS'na neden olan biyolojik faktörlerdir (Kalogerakis ve Ark., 2005). Küfler, yaşam alanı olarak rutubetli ve güneş görmeyen ortamları sevmektedir. Sıvası hasar gördüğü için su çeken duvarlarda; ev içi nem miktarı yüksek olduğu için nemlenen duvar kâğıtlarında, su boruları su sızdırdığı için yeşillenen banyo karolarında veya devamlı su aktığı için çürüyen mutfak dolaplarında oluşmaktadırlar. Ayrıca küfler, bakteriler, virüsler iç ortama ısıtma, havalandırma ve soğutma sistemlerinden, kapılardan, pencerelerden, duvar açıklıklarından, su tesisat borularından gelebildiği gibi, insanlar tarafından, özellikle de ayakkabı veya kıyafetleri ile de iç ortama taşınabilmektedirler (Ross ve Ark. 2000). Mikroorganizmaların iç ortamda büyümesini ise; iç ortamın nem oranı, sıcaklık ve besin (kir, odun, kağıt, boya vb.) varlığı ile oksijen ve ışık miktarı belirlemektedir.

Mikroorganizmalar bina içlerine girdikleri zaman gelişip çoğalabilecekleri çok farklı ortamlar bulabilmektedirler. Örneğin; nemli duvarlar, rutubetli ve karanlık köşeler, banyo ve mutfak dolapları, klimalar, çeşitli tip kumaşlar, giyecekler, yatak, yorgan, yastık vb. ile ev, ofis ya da okul binalarındaki duvardan duvara döşeli her tip dekoratif amaçlı kaplama malzemeleri, halı altları, duvar yüzeylerini kaplayan duvar kağıtları ya da değişik tip ahşap kaplama malzemeleri, bu tip malzemeyi sıkıştırmak ya da yapıştırmak amacı ile kullanılan dolgu maddeleri ile tutkal çeşitleri, tavan döşemeleri, asmolen tavanlar, bununla beraber bina ile bu tip dekoratif ya da yalıtım malzemesi arasında kalan boşlukta biriken tozlar, yalıtım amaçlı kullanılan malzemelerin içi ve üzeri mikroorganizmaların yerleşip gelişebilecekleri ortamlar

oluşturmaktadır. (Özyaral, 2003). Binaların mikroorganizmalar tarafından istila edilmesi binanın hastalanmasına, bu binalarda insanların yaşaması ve vakit geçirmesi kişilerin hastalanmasına neden olabilir.

HBS'da sık görülen etkenler *Saccharopolyspora rectivirgula* (Krasil'nikov ve Agre, 1964) Korn-Wendisch ve Ark., 1989, *Thermoactinomyces candidus* Kurup ve Ark., 1975, *Aspergillus fumigatus* Fresen. 1863; daha az sıklıkla görülen etkenler *Penicillium* türleri, *Aureobasidium pullulans* (de Bary & Löwenthal) G. Arnaud 1918, *Bacillus subtilis* (Ehrenberg 1835) Cohn 1872, *Cytophaga allerginae* Liebert et al., 1984, *Cutaneotrichosporon cutaneum* (Beurm., Gougerot & Vaucher bis) Liu et al., (2015)'dur. Küflerde yer alan *Stachybotrys* türü sık rastlanan bir etkendir. *Stachybotrys*'lerin ortamda bulunma oranı, diğer küf cinslerine göre daha düşük olmasına rağmen diğer bütün küflerden daha çok risk oluşturmaktadır. *Stachybotrys* mikotoksin üretir ve birçok bina eklentisinde hızla üreyebilmektedir.

Hasta Bina Sendromunun Önlenmesi

Hasta Bina Sendromuna bağlı olarak görülen semptomları azaltmak için kirletici emisyonlarının azaltılması aynı zamanda uygun iklimlendirme şartlarının sağlanması gerekmektedir. Bu amaçla aşağıda verilen öneriler göz önünde bulundurulmalıdır:

• HVAC bakımı periyodik olarak yapılmalı (Isıtma, soğutma ve iklimlendirme cihazları)
• Ortam ısısı ve nemi kontrol edilmeli
• Ev ve ofis gibi iç ortamlar iyi temizlenmeli ve tozlardan arındırılmalıdır.
• İç mekânlardaki ıslak ortamlara dikkat edilmeli, iç mekân nemini artıracak uygulamalar yapılmamalı
• Duvar kâğıdı kullanılmamalı, silinebilen yüzeyler oluşturulmalı
• Bina hava girişleri kirli hava ortamından uzak olmalı
• Yemek yapımında aspiratör kullanılmalı
• Nemli zeminler halıyla kaplanmamalı
• Mutfak ve banyo gibi nemli ortamlar sık havalandırılmalı, su sızıntıları önlenmeli ve aşırı nem oluşması engellenmelidir.
• Özellikle mutfak, banyo gibi ıslak zeminler ile çocuk ve oturma odaları mümkün olduğunca halı ve benzeri malzeme ile kaplanmamalıdır.
• HBS oldukça kompleks bir sorundur. Bu yüzden çözümü için farklı meslek uzmanların ortak çalışmasını gerektirmektedir. HBS'ye bağlı semptomların önlenmesi için mimarlar, mühendisler (çevre, makina vb.) ve sağlık personeli (hekim, hemşire, çevre teknikeri) işbirliği halinde çalışmalıdır.

"Hasta Bina Sendromu" kavramı yetmişli yıllarda ortaya çıktıktan sonra iç ortam kalitesini konu alan etkinlikler düzenlenmeye başlanmıştır. 90'lı yıllarda yurtdışında ve 2000'li yılların başında ülkemizde "akıllı bina", "sağlıklı bina" kavramları kullanılmaya başlanmış ve bu kavramlar ekseninde kuruluşlar oluşmaya başlamıştır. 1978 yılından itibaren İç Hava Kalitesi ve İklimi Uluslararası Konferansı (International Conference on Indoor Air Quality and Climate) başlığı altında uluslararası bilimsel faaliyetler düzenlenmektedir. Bu konferanslarda ki amaç; zamanımızın çoğunu geçirdiğimiz iç ortamın kalitesinin, konforunun, sağlık düzeyinin ve verimliliğinin artırılması, yeni binaların yapımı konusunda yenilikçi projelerin geliştirilmesidir (Walkinshaw, 1991). Ülkemizde son yıllarda sağlıklı bina-akıllı bina kavramı gelişmeye başlamıştır. Bu alanda sertifikasyon firmaları kurulmuştur. Bu firmalarda enerji- etkinlik, iç ortam hava kalitesi ve verimli su kullanımı konusunda sertifika verilmekte, izleme ve değerlendirme, danışmanlık gibi hizmetler sunulmaktadır.

Uygulamadaki boşluklar:

Sağlık kuruluşlarında muayene rutininde HBS sorgulanmakta mıdır?

HBS'dan şüphelenildiğinde binanın tanı ve tedavisi için hangi kurum ile iletişime geçilmektemidir?

HBS tanı ve tedavisi nasıl olmalıdır?

Hasta binaları muayene edip HBS kriterlerine göre tanı koyan ve tedavi eden kuruluşların oluşturulması bir çözüm olabilir mi?

2013 yılında 28710 sayılı Resmi Gazetede yayınlanan İşyeri Bina ve Eklentilerinde Alınacak Sağlık ve Güvenlik Önlemlerine İlişkin Yönetmelik işyerlerindeki bazı sağlık tedbirlerini içermektedir. Bina yapısı ve dayanıklılığı, kapalı alanların havalandırılması, ortam sıcaklığı ve aydınlatma, işyeri taban-tavan-duvar özellikleri, çalışma alanı boyutları gibi başlıklarda kurallar belirtilmektedir. Yönetmelik uygulanmasında ise Türk Standartları Enstitüsü'nün havalandırma, bina yapı işlerinde kullanılan malzeme standartları gibi rehberleri kullanılmaktadır (TS EN 13180/ TSE K 367). Ancak bu rehberler HBS oluşmaması için gerekli sağlık koşullarını sağlamak hususunda eksik kalmaktadır.

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TSE K 367 (Türk Standartları Enstitüsü / Cam elyaf takviyeli polimer kompozit donatı çubukları-Beton donatısı için Belgelendirme Kriteri).

CANDIDA SPECIES ISOLATED FROM BLOOD CULTURES AND EVALUATION OF ANTIFUNGAL SUSCEPTIBILITY TESTING

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ABSTRACT

Isolation of Candida species from one or more blood cultures is defined as candidaemia and it is a serious clinical condition with high mortality. Identification and antifungal susceptibility tests are important in determining appropriate and effective antifungal therapy. The aim of this study was to determine the distribution and antifungal susceptibility of Candida species isolated from blood culture samples. Blood cultures sent to Selçuk University Medical Microbiology Laboratory between January 2012 and June 2019 were analyzed retrospectively. VITEK 2 Compact® (bioMeriéux, France) system was used for identification and antifungal susceptibility tests. Of the total 278 strains, 139 was identified as (50%) *Candida albicans.* Resistance to amphotericin B was detected in 4 (2.9%) *C.albicans* isolates, 3 (9.3%) *C. glabrata* isolates, 2 (66.6%) *C. krusei* isolates and 2 (3.03%) *C. parapisolosis* isolates. Intravascular catheters, burns, use of antimicrobial drugs, long-term hospitalization, organ transplantation increase the risk of candida especially in intensive care units. Rapid and accurate identification and antimicrobial susceptibility testing in is important for directing treatment and controlling infection.

Key words: *Candida* species, blood cultures, antifunfal susceptibility, candidemia

Introduction: *Candida* species are opportunistic pathogens that cause infections more frequently in patients with immunodeficiency, especially in intensive care units. Isolation of *Candida* species from one or more blood cultures is defined as candidemia and it is a serious clinical condition with high mortality (Etiz P. et al.,2015). *Candida* spp. is the fourth most common cause of nosocomial blood circulation infection (Kılınçel Ö. et al., 2018).

The presence of central venous catheters, antibiotic therapy, previous surgical procedures, especially gastrointestinal system surgery, total parenteral nütrisyon (TPN) administration, colonization of *Candida* spp. Isolation of *Candida* species from one or more blood cultures is defined as candidemia and it is a serious clinical condition with higher mortality compared to septicemia cases with other pathogens (Çalışkan E. et al., 2013). *Candida albicans* is isolated most frequently, although candidemia agents vary according to geographical regions, but there has been an increase in the isolation of non-albicans species recently. Mortality rate in candidemias has been reported as 37.9-54%. *Candida glabrata* and *Candida tropicalis* have been reported to be associated with higher mortality and lower levels in *Candida parapsilosis* (Zer Y. ve Balcı İ, 2002).

The widespread use of empirical antifungal in recent years leads to a marked increase in the resistance rates of opportunistic fungal pathogens to commonly used antifungal agents. For this reason, identification and antifungal susceptibility tests are important in determining appropriate and effective antifungal therapy (Atalay MA. et al., 2012) .

The aim of this study was to determine the distribution and antifungal susceptibility of *Candida* species isolated from blood culture samples sent from service and intensive care units retrospectively. In addition, in vitro susceptibility patterns of *Candida* species to antifungal agents were investigated and it was aimed to guide treatment planning.

Materials and Methods: Blood cultures sent to Selçuk University Medical Microbiology Laboratory between January 2012 and June 2019 were analyzed retrospectively. Blood cultures sent to our laboratory in BACTEC Peds Plus for pediatric patients and BACTEC Plus aerobic media bottles for adults were incubated in the BACTEC-FX automated blood culture (Becton Dickinson, USA). Colony morphology and Gram staining were used as conventional methods in the identification of microorganisms that were grown at the end of incubation. In addition, susceptibility to amphotericin B, caspofungin, fluconazole, flucytosine and voriconazole were investigatedusingidentificationcards (YST) and antifungal susceptibility cards (AST-YST01) with VITEK 2 Compact® (bioMeriéux, France) system for identification and antifungal susceptibility tests.

Results: A total of 278 samples of *Candida* species were examined in blood cultures. Of the total 278 strains, 139 (50%) were identified as *Candida albicans*, 66 (23.6%) *Candida parapsilosis*, 32 (11.5%) *Candida glabrata*, 19 (6.89%) *Candida tropicalis*, 7 (2.56%) *Candida lusitaniae* (*Clavispora lusitaniae*) 4 (1.45%) *Candida pelliculosa*

(*Wickerhamomyces anomalus*), 4 (1.45%) *Candida guilliermondii* (*Meyerozyma guilliermondii*), 3 (1.07%) *Candida krusei* (*Issatchenkia orientalis*) and 2 (0.71%) *Candida kefyr* (*Kluyveromyces marxianus*).

Table 1. Distribution of resistance of isolated *Candida* species to antifungals

Candida types	Amphotericin B	Caspofungin	Flucytosine	Fluconazole	Micafungin	Voriconazole
C.albicans (139)	4 (2.87 %)	7 (5.03 %)	1 (0.71 %)	3 (2.15 %)	9 (6.47 %)	7 (5.03 %)
C.parapsilosis (66)	2 (3.03 %)	1 (1.51 %)			2 (3.03 %)	
C. glabrata (32)	3 (9.3 %)	1 (3.1 %)		2 (6.25 %)	1 (3.1 %)	
C.tropicalis (19)			1 (5.26 %)	1 (5.26 %)		
C.guilliermondii (4)		2 (50 %)		3 (75 %)		
C.krusei (3)	2 (66.6 %)					

TABLE 2. Distribution of isolated Candida species by units

UNITS	PERCENT (%)
Intensive care units	52.6 %
Internal sciences units	38.84 %
Surgical sciences units	9 %

Discussions: *Candida* species, which are responsible for more than 80% of nosocomial fungal infections and are among the leading agents of nosocomial blood circulation infections, are gaining importance day by day (Alışkan HE. et al.,2016). Significant increases have been observed in recent years, especially in infections caused by non-albicans *Candida* species. Five species (*C.albicans, C.parapsilosis, C. tropicalis, C. glabrata* and *C. krusei*) are isolated as agents in more than 95% of candidemias. Although the most common species is *C.albicans, C.parapsilosis* takes the first place in some studies (Doğan Ö. et al., 2016).

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. Sahiner et al. In the study, the most common factors were identified as *C.parapsilosis* (38.5%), *C. tropicalis* (30.8%) and *C.albicans* (26.9%), respectively. In our study, *C. albicans* (50%), *C. parapisolosis* (23.6%) and *C. glabrata* (11.5) were the first causes of candidaemia. Compared to other studies, the proportion of isolated *Candida* species was compatible.

Rapid and accurate antimicrobial susceptibility testing in clinical microbiology laboratories is important for directing treatment and controlling infection. Amphotericin B is a polyene derivative antifungal agent. Although rare resistance to amphotericin B, and some of the world's centers in various locations in Turkey in the rate (2-20%) amphotericin B resistance have been reported (Bayram Y. et al., 2012). The most sensitive species to amphotericin B is *C.albicans*. In our study, resistance to amphotericin B was found in 4 (2.9%) *C.albicans* isolates. Reduced susceptibility to amphotericin B may be observed in *C. glabrata* and *C. krusei* strains compared to *C. albicans*. In a three-year study in Taiwan, only three of the 383 *Candida* isolates isolated from blood were found to be resistant to amphotericin B (Cheng MF et al., 2004). *C. glabrata* isolates, 2 (66.6%) *C. krusei* isolates, 2 (3.03%) *C. parapisolosis* resistance was determined. The results of the study confirmed the decreased sensitivity of Amphotericin B in *C. krusei* and *C. glabrata* strains throughout the dream.

Caspofungin is a water-soluble, semi-synthetic echinocandin, which has good efficacy on *Candida* species. High MIC values of caspofungine were determined in *C.albicans* strains, which are known to have a high spectrum of action of echinocandins (Cuenca-Estrella M. et al., 2010) . According to our results, resistance was found in 7 (5.03%) *C.albicans* isolates, 1 (3.1%) *C. glabrata*, 1 (1.51%) *C. parapisolosis* isolates and 2 (50%) *C. guilemiondi* isolates.

Flucytosine is an antifungal agent that is a pyrimidine analogue. There are many studies reporting high rates of flucytosin resistance in *Candida* strains as well as very low resistance rates to flucytosine. Öztürk et al. Candida strains in their study, only one (3%) of *C.glabrata* isolates observed flucytosine resistance, all other *Candida* species were susceptible to flucytosine. Among the *Candida* strains included in our study, 1 (0.71%) *C.albicans* strain and 1 (5.26%) *C.tropicalis* strains were found to be resistant to flucytosine.

Fluconazole is a widely used antifungal agent due to its wide effect spectrum and low toxicity. In different studies, fluconazole resistance was determined at varying rates. Kuzucu et al. found a fluconazole resistance rate of 14% in all *Candida* isolates in a study performed in the intensive care unit. When we examined the distribution of fluconazole resistance according to the species evaluated, resistance was found in 3 (2.15%) *C.albicans* strains, 2 (6.25%) *C.glabrata* strains, 1 (5.26%) *C. tropicalis* strain and 3 (75%) *C. guilliermondii* strains. Since *C. krusei* is naturally resistant to fluconazole, it has not been evaluated and considered resistant. In addition, no resistance was found in the other species evaluated.

Mikafungin contains sodium active ingredient. It acts by inhibiting the production of a part of the wall structure of the fungal cell. According to the results, 9 (6.47%) *C.albicans* isolates, 1 (3.1%) *C. glabrata* and 2 (3.03%) *C.parapisolosis* isolates were found to be resistant.

Voriconazole is a broad spectrum, triazole antifungal agent that is effective on *Candida* spp., *C.neoformans*, *Trichosporon* spp., *Aspergillus* spp., *Fusarium* spp. and endemic dimorphic pathogens (Saracli MA et al., 2009). In the literature, there are studies in which all strains tested are susceptible to voriconazole, as well as studies that report resistant *Candida* strains (Öztürk T. et al., 2013). In our study, resistance to voriconazole was detected only in 7 (5.03%) *C.albicans* isolates, while no resistance was observed in the other *Candida* species included in the study.

According to our results, all the antifungals we tested were found to have different rates of resistance. For this reason, in the treatment of *Candida* infections it is considered that identification and antifungal susceptibility tests must be routinely performed. Determination of antifungal resistance profiles of *Candida* species will be guiding empirical

treatment by preparing both the antifungal use protocols of our hospital and the wider treatment protocols to be made throughout the country.

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EVALUATION OF GALACTOMANNAN ANTIGEN TEST RESULTS USED IN PREDIAGNOSIS OF INVASIVE ASPERGILLOSIS

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ABSTRACT

Detection of galactomanan antigen is important for early diagnosis and treatment in high risk patients for invasive aspergillosis. In this study, it was aimed to determine the galactomannan antigen positivity rates of the samples sent to our laboratory. Galactomannan (GM) test results of the Microbiology of Selcuk University Medical Faculty between January 1st, 2010 and June 01st, 2019 were investigated retrospectively. Sandwich enzyme immunoassay (ELISA) method was used to detect galactomannan antigens. Galactomannan antigen was found to be positive in 726 (24.84%) of 2923 samples. Monitoring of GM levels in consecutive serum samples is useful in antifungal treatment follow-up. In addition, it is very important to evaluate the test results in a laboratory and clinician collaboration.

Key words: Aspergillosis, galactomannan antigen, ELISA, Serological Diagnosis

Introduction: Invasive fungal infections are among the major health problems in recent years with a significant increase in incidence. The population of patients at risk for this disease are patients with hematologic malignancies, recipients of stem cell or solid organ transplantation and other immunosuppressed individuals for any reason (Birinci A. and Çaycı YA, 2016). The methods used in the diagnosis of invasive fungal diseases are direct microscopy, culture methods, serological methods and histopathological examinations. However, the insufficiency of sensitivity and specificity of these methods leads to difficulties in diagnosis, for example with difficulties in invasive procedures. Therefore, new methods are needed in addition to classical methods in the diagnosis of the disease (McLintock LA. And Jones BL, 2004). Galactomannan (GM) is a polysaccharide found in the cell wall of many Aspergillus species. GM can be detected in serum in the early stages of invasive aspergillosis without clinical symptoms. Detection of galactomanan antigen is important for early diagnosis and treatment in high risk patients for invasive aspergillosis (Verweij PE. and Meis JFGM, 2000).

Objective: In this study, it was aimed to determine the galactomannan antigen positivity rates of the samples sent to the Medical Microbiology Laboratory, the diversity of the samples, the units from which they were sent (outpatient clinic and service), to determine the diagnosis of the patients and to determine the galactomannan antigen positivity of the patients with definite diagnosis of aspergillosis.

Materials and Methods: Galactomannan antigen data which were studied in Selçuk University Medical Faculty, Medical Microbiology Laboratory between January 1, 2010 and June 01, 2019 were retrospectively investigated. In our study, sandwich enzyme immunoassay (ELISA) method was used to detect circulating galactomannan antigens in various samples using rat monoclonal EB-A2 antibodies. The study was carried out according to the instructions of the manufacturer (Dynamiker Biotechnology, China). The number of specimens, type of specimens, diagnosis of patients and units to which samples were sent (polyclinic or ward) were investigated.

Results: A total of 2923 samples were screened for galactomannan antigen in our laboratory. Galactomannan antigen was found to be positive in 726 (24.84%) of these samples. 302 (41.5%) serum, 419 (57.7%) bronchoalveolar lavage fluid (BAL), 1 (0.30%) pleural fluid, 4 (0.5%) sputum samples were positive. Pneumonia was detected in 311 (43.2%) patients, various malignancies (lung, ovary, breast, stomach, colon, esophagus) in 108 (15.1%), and various leukemias (acute myeloid, acute) in 44 (6.40%) patients, lymphoblastic, acute myelomonocytic chronic lymphocytic, chronic myeloid), chronic obstructive pulmonary disease (COPD) in 149 (20.1%), bronchitis or bronchiectasis in 114 (15.2%). GM was positive in 116 (45%) out of 258 patients (35.53%) with the diagnosis of aspergillosis. Galactomannan antigen positive samples; 212 (69.5%) from the Chest Diseases Department, 16 (5.24%) from the Chest Diseases Polyclinic, 4 (1.32%) from Chest Diseases Intensive Care Unit, 40 (13.2%) from the Hemotology Service, 16 (5.24%) were sent from Medical Oncology Service, 4 (1.02%) from Internal Medicine Intensive Care Unit, 8 (2.60%) from

Nephrology Service, 5 (1.88%) from Infectious Disease Service. The results of the study are shown in the following tables and figures.

Figure 1. Distribution of positive samples

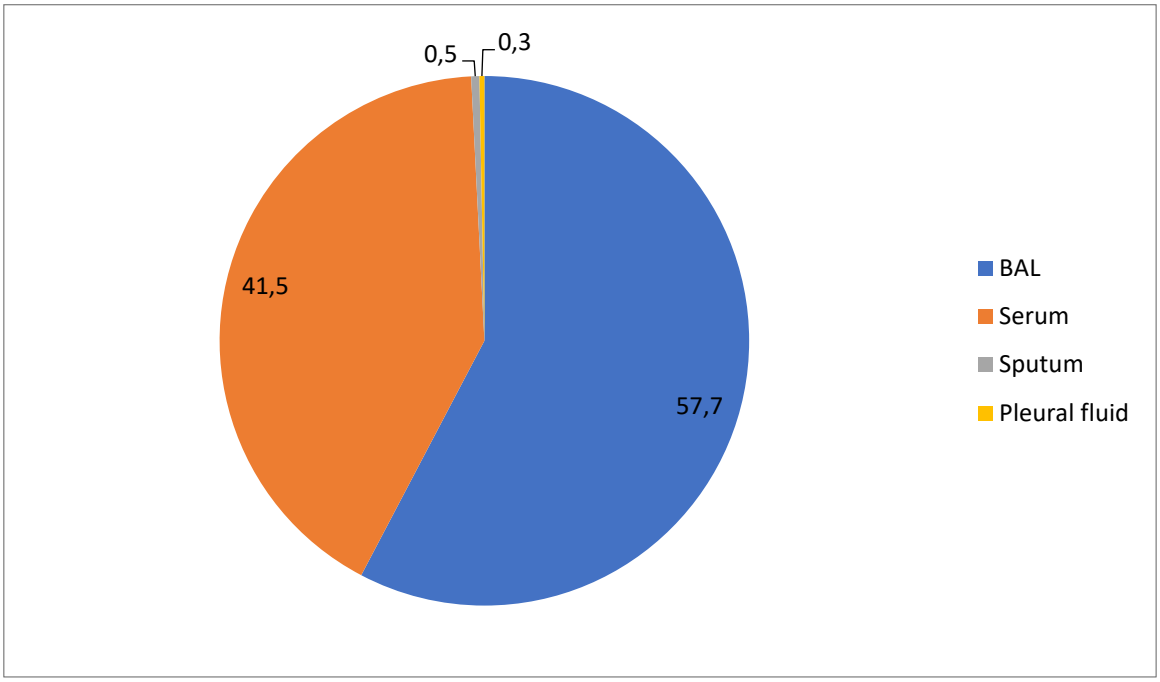

Figure 2. Distribution of positive samples according to Clinical Services

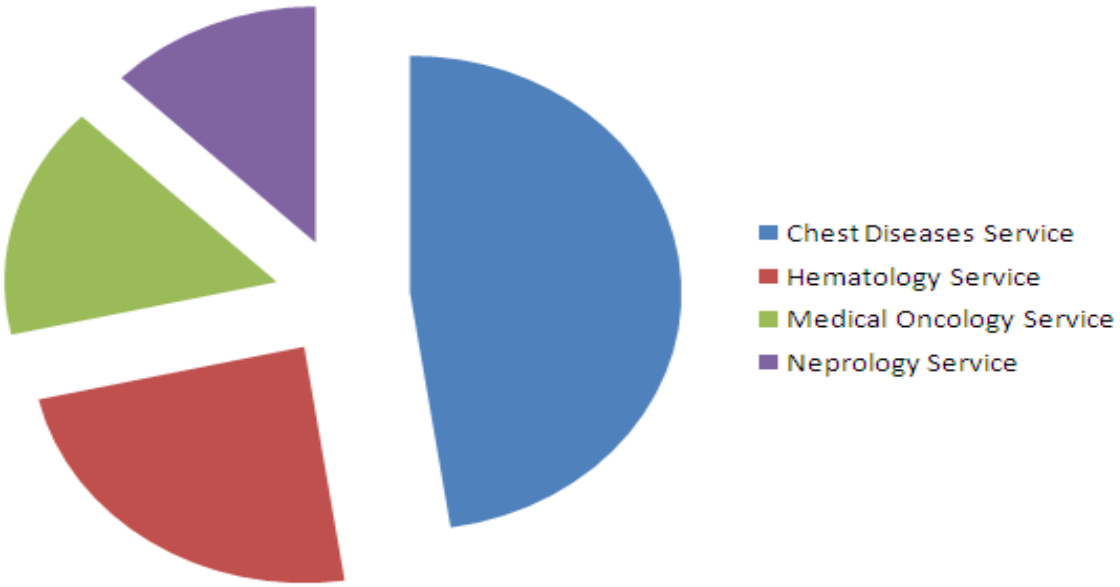

Table 1. Distribution of clinical diagnoses of positive patients

Diagnosis	Percent %
Pneumonia	43.2 %
COPD	20.1 %
Bronchitis or Bronchiectasis	15.2 %
Various Malignancies	15.1 %
Various Leukemias	6.40 %

Discussion: Accurate and effective use of galactomannan test is important in terms of timely initiation of antifungal therapy, minimizing toxic effects of discontinued antifungal agents. Some studies have reported over 90% sensitivity (Ağca HE. et al.,2014).

When the results of the Galactomannan test were interpreted, false positives: Bifidobacterium, piperacillin-tazobactam etc. beta lactam / combinations (2h when a single dose is discontinued, negative in multiple doses for 1-5 days), foods (pasta, cereals), bowel damage, molds (Penicillium, Fusarium, Alternaria, Mucorales, Paecilomyces, Geotrichum, Histoplasma). False positivity of BAL samples from 3-19% due to colonization should also be considered (Clancy CJ. et al,2007).

As the cause of false negative results in the studies; the presence of anti-Aspergillus antibodies, limited localization of infection, differences in GM synthesis and release among Aspergillus species and non-continuous circulation of GM (Clark TA. and Hajjeh RA, 2002). Serum storage conditions are also a factor of false negativity. In addition, empirical or prophylactic antifungal therapy may cause false negative results (Kauffman CA, 2006).

In this study, only 116 of the patients diagnosed with aspergillosis were positive for GM and the sensitivity was 45%. This decrease is thought to be due to the fact that the study group was not selected from a group of patients at specific risk and that the sampling time was not privatized.

In some studies with experimental animals, it has been reported that there is a direct correlation between the degree of GM antigenemia and the fungal load in the tissue (Yeo SF. and Wong B, 2002). The effect of GM detection in the early diagnosis of invasive aspergillosis was investigated in 100 patients who underwent allogeneic stem cell transplantation (McLintock LA. and Jones BL, 2004). For this reason, it is recommended to study two serum samples per week. In addition, the results of the test should be evaluated in cooperation with the clinician in order to correlate the serological diagnosis with the clinical diagnosis (Wheat LJ, 2003).

According to the results of the study, 419 (57.7%) of the samples were tested from BAL. In the study of Ağca et al. reported that GM test contributes to early diagnosis when the positivity of bronchoalveolar lavage and bronchial lavage is compared with GM values and that if the GMI is ≥1, fungal growth can be expected in culture. In the BAL sample of 81 patients who underwent solid organ transplantation, GM was investigated and sensitivity was 100% and specificity 90.8% when the GM cutoff was ≥1. In addition, BAL GM test was reported to be better than serum GM and BAL cytology and culture. However, false positive results were obtained in five out of 12 patients who underwent lung transplantation, which was due to the fact that this group of patients had Aspergillus spp. It may be contaminated with species. When the patients who underwent lung transplantation were excluded, the specificity increased to 92.9%.

According to the research data, 44 (6.40%) of the patients who were positive for GM had various leukemia diagnoses. Invasive aspergillosis (IA) can be fatal, especially in patients with hematologic malignancy. Therefore, it is important to carry out the GM test for the early diagnosis of IA in such patients in order to prolong their survival.

In conclusion, monitoring of GM levels in consecutive serum samples is useful in antifungal treatment follow-up. In addition, it is very important to evaluate the test results in a laboratory and clinician collaboration When GM test results are consistent with clinical data, it is very helpful in the diagnosis of IA. Therefore, it is thought that clinical, pathology, culture and microscopic methods and serological tests should be performed in appropriate patient population and in appropriate frequency will contribute to the diagnosis of invasive aspergillosis infections and contribute to the reduction of mortality and morbidity.

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FATTY ACID COMPOSITION OF CULTIVATED *LENTINULA EDODES*

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ABSTRACT

Lentinula edodes (Berk.) Pegler, as called Shiitake mushroom, is an edible fungus native to East Asia and contains several therapeutic actions such as antioxidant and antimicrobial properties. This work aimed to evaluate fatty acid composition of dried powder formulations of cultivated *L. edodes* in Konya, Turkey for the first time. The fatty acid composition was analyzed by Gas Chromatography (GC) equipped with Flame Ionization Detector (FID) after formations of methyl esters. Major saturated fatty acid (SFA), monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) were palmitic acid (18.06%), oleic acid (2.78%) and linoleic acid (66.84%) in *L. edodes*, respectively. The total PUFA percentage (67.77%) was higher than the total SFA and MUFA percentages (26.32% and 5.92%, respectively). The results obtained in this study are consistent with the results of studies conducted in India and Brazil. As a result, *L. edodes*, an edible mushroom, may be a valuable in terms of PUFA and especially linoleic acid for human diets.

Key words: cultivated, fatty acid, Shiitake mushroom.

Kültür *Lentinula edodes*'in Yağ Asidi Kompozisyonu

ÖZ

Shiitake mantarı olarak ta adlandırılan *Lentinula edodes* (Berk.) Pegler Doğu Asya'ya özgü yenilebilir bir mantardır ve antioksidan ve antimikrobiyal özellikler gibi bazı terapötik etkiler içerir. Bu çalışma, Konya Türkiye'de yetiştirilen kültür *L. edodes*'in kuru toz formülasyonunun yağ asidi kompozisyonunu ilk kez değerlendirmeyi amaçlamıştır. Yağ asidi kompozisyonu, metil esterlerin oluşumundan sonra Alev İyonlaşma Detektörü (FID) ile donatılmış Gaz Kromatografisi (GC) ile analiz edildi. *L. edodes*'te majör doymuş yağ asidi (SFA) %18.06 oranla palmitik asit, majör tekli doymamış yağ asidi (MUFA) %2.78 oranla oleik asit ve majör aşırı doymamış yağ asidi (PUFA) %66.84 oranla linoleik asittir. Total PUFA yüzdesi (%67.77), total SFA (%26.32) ve MUFA (%5.92) oranlarından daha yüksektir. Bu çalışmada elde edilen sonuçlar Hindistan ve Brezilya'da yapılan çalışmaların verileriyle de uyumludur. Sonuç olarak, yenilebilir bir mantar olan *L. edodes*, PUFA ve özellikle linoleik asit açısından insan diyetleri için değerlidir.

Anahtar kelimeler: kültür, yağ asidi, Shiitake mantarı.

Giriş

Kültürü yapılan veya doğal olarak yetişen mantarlar ülkemizde de tüm dünyada olduğu gibi başta gıda olmak üzere yoğun bir şekilde tüketilmektedir. Gıda olarak tüketilmesinin yanı sıra ölü veya canlı organik maddeleri parçalayarak karbon ve azot döngüsünde de rol oynarlar. Yenilebilir mantarlar iyi bir lif kaynağı olup kitin, hemisellüloz, mannan ve betaglukanları içerir (Türkekul, 2017). Mantarlar besinsel değerlerinin ve aromalarının yanı sıra antioksidan, antikanserojen, antimikrobiyal ve immünostimülan gibi biyolojik etkilere de sahiptirler. Geniş bir biyolojik aktivite yelpazesine sahip olmaları sebebiyle mantarların özellikle ilaçlara alternatif olma yolunda önemleri her geçen gün daha da artmaktadır. *Ganoderma, Pleurotus, Lactarius, Auricularia, Hericium* ve *Lentinula* gibi cinslere ait bazı mantar türleri sahip oldukları biyolojik aktiviteleriyle tıbbi açıdan dikkat çekmektedirler (Üstün, 2011).

Lentinula edodes (Berk.) Pegler Shiitake mantarı olarak da adlandırılmakta olup dünyada kültürü yapılan mantar üretiminin %10'unu oluşturmaktadır. Özellikle Uzakdoğu ülkeleri olmak üzere Asya, Avrupa ve Amerika'da üretimi artmakta olan Shiitake mantarı taze ve kurutulmuş olarak tüketilmektedir. Protein, vitamin ve mineral maddeler bakımından oldukça zengin olması yanı sıra bünyesinde bulunan Lentinan maddesinin bir kanser tedavisinde olumlu sonuç vermiş olması sebebiyle tıp alanında kullanılması *L. edodes*'e olan ilgiyi artırmaktadır (Özçelik ve Pekşen, 2006).

Yenilebilir mantarların besin ve ticari değerleri aroma ve tat gibi kendi organoleptik özelliklerinden, bunun yanı sıra zengin karbonhidrat, lif, mineral, vitamin ve yüksek oranda doymamış yağ asidi içeriğinden kaynaklanmaktadır. Yüksek protein ve düşük yağ/enerji miktarı, yenilebilen yabani mantarları düşük kalorili diyetlerde kullanmak için harika bir besin kaynağı yapmaktadır (Acay, 2018). Bu çalışmada Türkiye'de doğal yayılış göstermeyen bununla birlikte son yıllarda ülkemizde kültür yetiştiriciliğiyle gündeme gelen *L. edodes*'in kültür formunun kurutulmuş toz örneğinin yağ asiti kompozisyonunun gaz kromatografisi (GC) yöntemiyle belirlenmesi amaçlanmıştır.

Materyal ve Metot

Kültür *L. edodes* örnekleri (Şekil 1) Selçuk Üniversitesi Mantarcılık Uygulama ve Araştırma Merkezi Müdürlüğü'ndeki kültür ortamından elde edildi ve laboratuarda özel kurutma dolaplarında 40-45°C'de kurutularak değirmende toz haline getirildi. Mantar örneklerinin yağ ekstraksiyonları petrol eteri kullanılarak Sokslet aparatında gerçekleştirilirken, yağ asitlerinin gaz kromatografik analizleri için metilleştirilmeleri IUPAC (1979) metodundan yararlanılarak gerçekleştirildi. Yağ asitlerinin metilleştirilmesinde BF3-metanol (bortriflorür-metanol) kompleksi kullanıldı.

Gaz kromatografik analizler HP (Hewlett Packard) Agilent marka, HP 6890 N model, FID (Flame Ion Detector, alev iyon dedektör) dedektörlü otomatik injektörlü GC ile gerçekleştirilmiştir. GC'de injektör bloğu sıcaklığı 250 °C, dedektör bloğu sıcaklığı 280 °C olarak ayarlanmıştır. Kolona sıcaklık programı uygulanmıştır. Kolonun başlangıç sıcaklığı 60 °C olarak ayarlanmış, bu sıcaklıkta 1 dakika bekletilmiş daha sonra dakikada 20 C° artarak 190 °C 'ye ulaşılmıştır. Bu sıcaklıkta 60 dakika bekletilmiştir. Bu sıcaklığı takiben dakikada 1 °C artarak 220 °C 'ye ulaşılmış ve bu sıcaklıkta 10 dakika bekletilmiştir. Sonuçta analizler 107.5 dakikada tamamlanmıştır. Taşıyıcı gaz olarak Helyum (1 ml/min) kullanılmıştır. Gaz kromatografın gaz akış hızları; hidrojen: 45 ml/dk, kuru hava: 400 ml/dk ve taşıyıcı gaz olarak kullanılan helyum: 1 ml/dk olarak ayarlanmıştır. Analiz için metilleştirilmiş yağ asidi numunelerinden bir mikrolitre gaz kromatografi cihazına injekte edilmiştir. Gaz kromatografi cihazında numuneler 3 tekrarlı olarak analizlenmiştir.

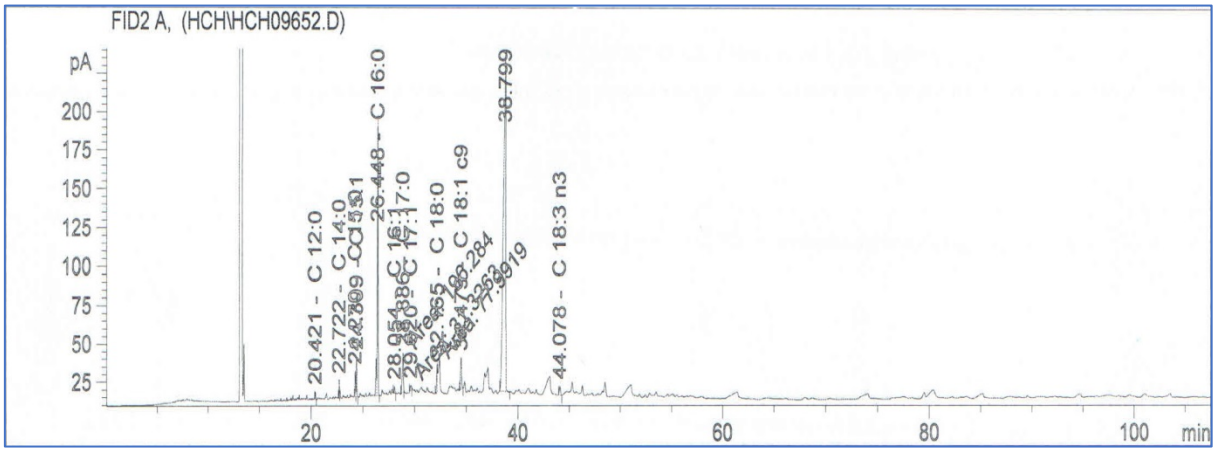
Kromatogramlardaki piklerin (Şekil 2) hangi yağ asidine ait olduğu standartların (Alltech ve Accu) bağıl alıkonma zamanları (relative retantion time) ile karşılaştırılarak belirlenmiştir. Sonuçlar yüzde alan (%) şeklinde üç GC analiz sonucunun Aritmetik Ortalaması ± Standart sapma şeklinde tablo halinde verilmiştir.

Şekil 1. *Lentinula edodes*'in kültür ortamındaki görünümü.

Bulgular ve Tartışma

Tablo 1'de, bu çalışmada kültür *L. edodes* örneklerinde tespit edilen yağ asitlerinin çeşitleri ve % oranları görülmektedir.

Tablo 1'de de görülebileceği gibi majör doymuş yağ asidi (Saturated Fatty Acid, SFA) %18.06 oranla C 16:0 Palmitik asit, majör tekli doymamış yağ asidi (Monounsaturated Fatty Acid, MUFA) %2.78 oranla C 18:1 ω9 Oleik asit ve majör aşırı doymamış yağ asidi (Polyunsaturated Fatty Acid, PUFA) %66.84 gibi yüksek bir oranla C 18:2 ω6 Linoleik asit olarak tespit edilmiştir.



Şekil 2. Bir kromatogram ve piklerin görünümü.

Tablo 1. Kültür *Lentinula edodes*'in yağ asidi kompozisyonu

Yağ asitleri	**% Oran (Ort ± S.S.[x])**
C 12:0 Laurik	0.33 ± 0.00
C 14:0 Miristik	1.05 ± 0.23
C 15:0 Pentadesilik	1.33 ± 0.02
C 16:0 Palmitik	18.06 ± 0.18
C 17:0 Margarik	3.92 ± 0.20
C 18:0 Stearik	1,64 ± 0.20
ΣSFA Total Doymuş	**26.32 ± 0.43**
C 15:1 ω5 Pentadekanoik	2.12 ± 0.01
C 16:1 ω7 Palmitoleik	0.35 ± 0.11
C 17:1 ω8 Margaroleik	0.67 ± 0.10
C 18:1 ω9 Oleik	2.78 ± 0.04
ΣMUFA Total Tekli Doymamış	**5.92 ± 0.06**
C 18:2 ω6 Linoleik	66.84 ± 0.39
C 18:3 ω3 Linolenik	0.94 ± 0.02
ΣPUFA Total Çoklu Doymamış	**67.77 ± 0.37**

[x] Veriler üç tekrarın ortalamasıdır; Aritmetik Ortalama ± Standart Sapma.

Ayrıca %66.77 olan total PUFA yüzdesinin hem %26.32'lik total SFA hem de %5.92'lik total MUFA oranlarından oldukça yüksek olduğu dikkat çekmiştir.

Longvah ve Deosthale (1998) Kuzeydoğu Hindistan bölgesinden toplanan yabani *L. edodes* örneklerinin yağ asidi kompozisyonu GC yöntemiyle incelemiş ve C 16:0 Palmitik asit oranını %19.2, C 18:1 ω9 Oleik asit oranını %8.3, C 18:2 ω6 Linoleik asit oranını %68.8, total SFA oranını %22.3 ve total doymamış yağ asidi (UFA) oranını %77.7 olarak rapor etmiştir. Bizim çalışmamızda Oleik asit oranının daha düşük tespit edilmesi dışında bu çalışmada elde ettiğimiz sonuçlarımız Longvah ve Deosthale (1998)'ın sonuçlarıyla uyumlu gözükmektedir. Farklılıklar bizim çalışmamızda *L. edodes*'in kültür formunun diğer çalışmada ise yabani formun kullanılmasından kaynaklanabilir.

Carneiro ve ark. (2013) Brezilya'da kapsül şeklinde ticari besin takviyesi olarak satılan *L. edodes*'in kurutulmuş toz formülasyonunun yağ asidi kompozisyonunu GC yöntemiyle incelemiş ve C 16:0 Palmitik asit oranını %11.78, C 18:1 ω9 Oleik asit oranını %3.28, C 18:2 ω6 Linoleik asit oranını %78.59, total SFA oranını %16.72, total MUFA oranını %3.45 ve total PUFA oranını %79.84 olarak rapor etmiştir. Carneiro ve ark. (2013)'nın çalışmasında palmitik asit oranının bizim çalışmamızdaki orana kıyasla daha düşük olması dışında iki çalışmanın sonuçları uyumlu görünmektedir.

Hem bizim çalışmamızda hem de yukarıda bahsedilen çalışmalarda ortak olan önemli bir sonuç *L. edodes*'de total PUFA oranının hep en yüksek oranda gözlenmesidir. İkincisi de tüm çalışmalarda C 18:2 ω6 Linoleik asit oranının en yüksek orandaki yağ asidi olmasıdır.

Yağlar yüksek enerji kaynağı olmasının yanında, yağda çözünen vitaminleri bulundurmaları, kan lipit düzeylerinde rol oynamaları ve proteinlerle birleşerek lipoproteinleri oluşturmaları açısından oldukça önemlidirler (Yücecan ve Baykan 1981). Bazı yağlar vücutta sentezlenemeyen Linoleik, Linolenik ve Arakidonik gibi esansiyel yağ asitleri bulunan gliseritleri de içerdiğinden, beslenme açısından değerleri daha yüksektir. Bu yağ asitlerinin vücuda dışarıdan alınması zorunludur ve memelilerin beslenmesi için esansiyel olduğu bilinen yağ asitleridir (Chapman ve ark. 2000; Murray ve ark. 1993).

ω6 PUFA'lar, insan vücudunda çok büyük etkilere sahip olan eikosanoid (prostoglandinler ve tromboksanlar gibi) metabolizmasında düzenleyici rollere sahip oldukları gibi ω3 PUFA'lar trigliserid ve kolesterol seviyesini düşürmede oldukça etkilidir (Kinsella 1987).

Yüksek kolesterolden ileri gelen hastalıkların, önemli oranda kırmızı etten kaynaklandığı artık bütün insanlar tarafından bilinmektedir. Bunun için daha sağlıklı olan doymamış yağ asitleri yani PUFA yönünden zengin olan gıdalar tüketilmesi tavsiye edilmektedir (Simopoulos 1991). Bu açıdan mantarlar daha da öne kazanmaktadırlar.

Sonuç olarak; yüksek PUFA içeriği ve esansiyel bir yağ asidi olan Linoleik asit içeriğinin çok yüksek olması insan sağlığı için Shiitake mantarını diyette tüketilmesi gereken değerli bir besin yapmaktadır.

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CULTIVATION OF KING OYSTER MUSHROOM (*PLEUROTUS ERYNGII* (DC. EX FR.) QUEL.) ON MIXTURE OF *TRIFOLIUM REPENS* L. AND PAPER WASTES

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ABSTRACT

The oyster mushrooms (*Pleurotus* spp.) are in the third place after the white button and shiitake among the world mushroom production. King oyster mushroom (*P. eryngii*) belongs to the family of oyster mushrooms, which is edible, basidiomycetic and saprophytic. It is considered as the best one of all *Pleurotus* species due to its excellent consistency of cap and stem, culinary qualities and longest shelf life than any other oyster mushroom.

This study investigated the possible use of local wastes for the cultivation of *P. eryngii*. For the propagation of the main culture, potato dextrose agar was used whereas barley grains were used for the propagation of spawn. For the formation of basidiocarp, mixture of *T. repens* and paper wastes (1:1) was used as culture media.

The spawn run time was 16 d, time to first primordia initiation was 31 d, time to first harvest days was 38 d, the first yield was 171.3 g, time to second primordia initiation was 47 d, time to second harvest days was 55 d, the second yield was 145.0 g, time to third primordia initiation was 65 d, time to third harvest days was 72 d, the third yield was 70.0 g, time to fourth primordia initiation was 78 d, time to fourth harvest days was 86 d, the fourth yield was 96.0 g, time to fifth primordia initiation was 97 d, time to fifth harvest days was 104 d, the fifth yield was 63.20 g, and time to sixth primordia initiation was 109 d, time to sixth harvest days was 117 d, and the sixth yield was 66.0 g.

Based on the results, mixture of *T. repens* and paper wastes (1:1) can be used for the cultivation of *P. eryngii*.

Key words: *P. eryngii*, paper waste, *T. repens*, king oyster mushroom, biotechnology, food

Introduction

From the ancient times, mushrooms have been recognized as important food items because of their taste, flavor, high nutritional values, and several medicinal properties. Mushrooms of *Pleurotus* genus (under the class basidiomycetes) are commonly regarded as oyster mushrooms, which are edible and among the most popular mushrooms world wide. Mushrooms of *Pleurotus* genus *include P. ostreatus*, *P. sajor-caju*, *P. florida*, *P. eryngii*, *P. cystidiosus*, *P. sapidus*, *P. eryngii*, *P. tuberregium*, *P. pulmonarius*, *P. citrinopileatus*, *P. djamor* and others, some of which are of a special consideration due to their high nutritional values and medicinal importance (Sanchez 2010; Khan and Thania, 2012; Kalac, 2013).

Edible mushrooms have been eaten and appreciated for their flavor, economical and ecological values, and medicinal properties. They are able to grow under different climatic conditions on cheap, readily available waste materials. These mushrooms are a clear example of how low-value waste, which is produced primarily through the activities of the agricultural, forest, and food-processing industries, can be converted to a higher value material useful to mankind (Sanchez, 2010).

Cultivation of edible mushrooms is a biotechnological process for lignocellulosic organic waste recycling. It might be the only current process that combines the production of protein-rich food with the reduction of environmental

pollution. The production of mushrooms is regarded as the second most important commercial microbial technology next to yeast (Pathak et al., 2009; Sanchez, 2010).

The *Pleurotus eryngii* species complex comprises at least six varieties and species (var. *eryngii* (DC.: Fr) Quel., *ferulae* Lanzi, var. *elaeoselini*, var. *tingitanus*, var. *tuoliensis* C.J. Mou, var. *hadamardii*, var. *fossulatus* and *nebrodensis* (Inzenga) Sacc.). This species is unique among the genus *Pleurotus* because in nature it is found in association with certain species of the Apiaceae (Umbelliferae) and Asteraceae (Compositae) families (Estrada et al., 2010). *P. eryngii* is one of the most valued and delicious mushrooms which are commercially cultivated on various agro-wastes. *P. eryngii* mushroom successfully cultivated on many agricultural and agro-industrial wastes including various sawdust, wheat straw, cotton waste, peanut shells, sugar cane bagasse, wheat, rice bran, millet straw, and soybean straw etc. (Ohga, 2000; Obatake et al., 2003; Bao et al., 2004; Ohga and Royse, 2004; Akyüz and Yıldız, 2008; Kırbag and Akyüz, 2008ab; Hassan et al., 2010).

The possibility of using local cellulosic such as mixture of *T. repens* and paper wastes (1:1) for the cultivation of *P. eryngii* was studied in the present investigation.

Material and Method

The propagation of mycelium, spawn preparation and condition of cultivation were determined according to the methods described by Zadrazil (1978).

Inoculum preparation

The main culture of *Pleurotus eryngii* (DC ex Fr.) Quel. was obtained from Biology Department, Science and Arts Faculty, University of Bitlis Eren, Bitlis, Turkey. For the propagation of the main culture, potato dextrose agar (PDA) was used. A mycelium/agar plug was inoculated at the center of the plate and incubated at 25°C in the dark on average for ten days.

Spawn preparation

One kilogram of barley grains was used in the production of spawn. The grains were cooked for 40 min, washed in flowing water and drained. The grains were supplemented with 2 g limeand 8 g gypsum and mixed manually. A 100 g sample of grain was then placed in a 250 ml erlenmayer flask and sterilized in an autoclave at 121ºC for 15 min. After cooling, each flask was inoculated with two agar disks (6 mm diameter) containing the mycelium and incubated at 25ºC in total darkness for two weeks.

Conditions of cultivation

For the formation of basidiocarp, *T. repens* and paper wastes were used as culture medium. These local wastes were obtained from the vicinity of Bitlis,Turkey. One kilogram of *T. repens* was placed in plastic buckets and kept for 48 h until the compost reached a humidity of 70-75%. The compost was emptied into plastic bowls and also supplemented with one kg of paper waste. To obtain the desired pH (5.5-6.5), 35 g of lime and 35 g of gypsum were added to 1 kg of compost. Compost medium was mixed manually and sterilized in autoclave at 121ºC for 30 min. After cooling, the spawn grown on 100 g was used for 1 kg dried material as inoculation material. Of inoculated composts 1000 g samples were placed in polyethylene bags of 20 cm x 30 cm diameter. The lids of the bags were tied up and taken into incubation room at 25±1°C in the dark for two weeks. Incubation was done in a room at 16-18±1° C for formation of basidiokarp. One air cooler was used 2 h daily for aeration to avoid the accumulation of CO_2. The culture room was provided with light from fluorescent bulbs with an intensity of 1000 lux for 12 h a day. The culture room was constantly wet to maintain the required relative humidity (75±5%). The cultures were irrigated by spraying water once or twice a day.

Result and Discussion

The effect of some lignocellulosic waste on the growing periods and product yield of *P. eryngii* is shown in Table 1-2. *P. eryngii* was cultivated on various agro-residues for about 105 days, during which six fleshings were made (see Table 2).

The spawn run time was 16 d, time to first primordia initiation (Figure 1) was 31 d, time to first harvest days was 38 d, the first yield was 171.3 g, time to second primordia initiation was 47 d, time to second harvest days was 55 d, the

second yield was 145.0 g, time to third primordia initiation was 65 d, time to third harvest days was 72 d, the third yield was 70.0 g, time to fourth primordia initiation was 78 d, time to fourth harvest days was 86 d, the fourth yield was 96.0 g, time to fifth primordia initiation was 97 d, time to fifth harvest days was 104 d, the fifth yield was 63.20 g, and time to sixth primordia initiation was 109 d, time to sixth harvest days was 117 d, and the sixth yield was 66.0 g (see Table 1-2, Figure 2).

In *Pleurotus* spp. the primordial initiation was generally observed on day 20-30 (Khanna et al., 1992; Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003). In *P. eryngii* the total harvest period was generally observed on the 30-108 days (Ohga, 2000; Philippoussis et al., 2001; Obatake et al., 2003; Bao et al., 2004; Ohga and Royse, 2004; Akyüz and Yıldız, 2008).

The aforementioned studies have reported various values for the yield, which may have arisen from the biological structure of substrate used for the culture. In previous studies (Khanna et al., 1992; Ragunathan et al., 1996; Philippoussis et al., 2001; Obatake et al., 2003; Ragunathan and Swaminathan, 2003; Bao et al., 2004; Ohga and Royse, 2004; Ohga, 2000; Akyüz and Yıldız, 2008), different locally available agricultural wastes were used as substrates for the culture of *Pleurotus* spp. Also mixed materials may be used in culture of mushrooms. Different results were obtained depending on the material in culture medium, structure of the compost and cultivation methods and techniques used for the culture.

Based on the results, mixture of *T. repens* and paper wastes (1:1) can be used for the cultivation of *P. eryngii*.

Table 1. Effect of various residues on growing periods of *P. eryngii* (days).

Mycelium Growing Days	First Primordia Initiation	First Harvest Days	Second Primordia Initiation	Second Harvest Days	Third Primordia Initiation	Third Harvest Days	Fourth Primordia Initiation	Fourth Harvest Days	Fifth Primordia Initiation	Fifth Harvest Days	Sixth Primordia Initiation	Sixth Harvest Days
16	31	38	47	55	65	72	78	86	97	104	111	117

Table 2. Effect of various residues on yield of *P. eryngii* (g/kg).

First Yield	Second Yield	Third Yield	Fourth Yield	Fifth Yield	Sixth Yield
171.3	145.0	70.0	96.0	63.20	66.0

Figure 1. Primordia of *P. eryngii*

Figure 2. Fruit bodies of *P. eryngii*

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EVALUATION OF MIXTURE OF *MEDICAGO SATIVA* L. AND PAPER WASTES FOR THE CULTIVATION OF *PLEUROTUS FLORIDA*

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ABSTRACT

The chief mushroom varieties cultivated are *Agaricus bisporus* (J.E. Lange) Imbach, *Lentinus edodes* (Berk.) Singer and the oyster mushroom, *Pleurotus ostreatus* (Jacq.) P. Kumm. Cultivation of these mushrooms represents a major industry in the countries of south east Asia. *Pleurotus* species are popular and widely cultivated throughout the world mostly in Asia and Europe owing to their simple and low cost production technology and higher biological efficiency.

The objective of this study was to evaluate the suitability of mixture of *M. sativa* and paper wastes for the cultivation of *P. florida*. For the propagation of the main culture, 2.0% malt-extract agar was used whereas wheat grains were used for the propagation of spawn. For the formation of basidiocarp, mixture of *M. sativa* and paper wastes (1:1) were used as culture media.

The mycelium growing period was 15.8±0.5 d, first primordia initiation was 27.8±1.3 d, first harvest days was 35.3±0.5 d, the first yield was 265.5±31.4 g, second primordia initiation was 47.3±8.8 d, second harvest days was 52.5±7.4 d, the second yield was 61.1±34.3 g, third primordia initiation was 67.5±7.5 d, third harvest days was 73.5±7.5 d, the third yield was 27.3±11.8 g, and total yield was 353.9±20.1 g per 1000 g of material (70% moisture).

Based on the results obtained, it was observed that the average yield of 35% was obtained by using 1:1 ratio of *M. sativa* and paper wastes.

Key words: *P. florida*, paper waste, *M. sativa*, oyster mushroom, mushroom cultivation, wastes

Introduction

Mushrooms have been eaten and appreciated for their flavor, economical and ecological values, and medicinal properties for many years. There are several hundreds of wild species of edible mushrooms yet only about 20 species are cultivated and used more extensively as food (Kalač, 2013) and only 10 species are cultivated on an industrial scale (Reis et al., 2012). Over the last 10 years edible mushrooms have been receiving an increased attention from researchers. The most commonly eaten species are *Agaricus bisporus, Lentinula edodes,* and the oyster mushroom, *Pleurotus ostreatus* (Ghorai et al., 2009). Cultivation of these mushrooms represents a major industry in the countries of south east Asia. *Pleurotus* species are popular and widely cultivated throughout the world mostly in Asia and Europe owing to their simple and low cost production technology and higher biological efficiency. Mushrooms represented a market of 63 billion US dollars in 2013. This market represents medicinal mushrooms (38%) and wild (8%) and cultivated edible (54%) mushrooms. At a global scale, consumption of mushrooms has increased from 1 to 4.7 kg of cultivated edible mushrooms per capita in the period 1997 to 2013 (Royse et al., 2017).

Commercial mushrooms are produced on lignocellulose such as straw, saw dust, and wood chips. As such, mushroom-forming fungi convert low-quality waste streams into high-quality food. Many mushroom-forming fungi belonging to the class of primary decomposers can be cultivated on a range of lignocellulosic material, including various types of straw, cotton seed hulls, corn cobs, peanut shells, cotton from textile industry, coffee pulp, paper (Sánchez, 2010).

In this paper we report that mixture of *M. sativa* and paper wastes can be used as the substrate for cultivation of oyster mushroom (*Pleurotus florida*).

Material and Method

The propagation of mycelium, spawn preparation and condition of cultivation were determined according to the methods described by Zadrazil (1978).

Inoculum preparation

The main culture of Pleurotus florida was obtained from Biology Department, Science and Arts Faculty, University of Bitlis Eren, Bitlis, Turkey. For the propagation of the main culture, 2% malt-extract agar (PDA) was used. A mycelium/agar plug was inoculated at the center of the plate and incubated at 25°C in the dark on average for ten days.

Spawn preparation

One kilogram of wheat grains was used in the production of spawn. The grains were cooked for 40 min, washed in flowing water and drained. The grains were supplemented with 2 g limeand 8 g gypsum and mixed manually. A 150 g sample of grain was then placed in a 250 ml erlenmayer flask and sterilized in an autoclave at 121ºC for 15 min. After cooling, each flask was inoculated with two agar disks (6 mm diameter) containing the mycelium and incubated at 25ºC in total darkness for two weeks.

Conditions of cultivation

For the formation of basidiocarp, M. sativa and paper wastes were used as culture medium. These local wastes were obtained from the vicinity of Bitlis,Turkey. One kilogram of M. sativa was placed in plastic buckets and kept for 48 h until the compost reached a humidity of 70-75%. The compost was emptied into plastic bowls and also supplemented with one kg of paper waste. To obtain the desired pH (5.5-6.5), 35 g of lime and 35 g of gypsum were added to 1 kg of compost. Compost medium was mixed manually and sterilized in autoclave at 121ºC for 15 min. After cooling, the spawn grown on 150 g was used for 1 kg dried material as inoculation material. Of inoculated composts 1000 g samples were placed in polyethylene bags of 20 cm x 30 cm diameter. The lids of the bags were tied up and taken into incubation room at 25±1°C in the dark for two weeks. Incubation was done in a room at 20-22±1° C for formation of basidiokarp. One air cooler was used 2 h daily for aeration to avoid the accumulation of CO_2 . The culture room was provided with light from fluorescent bulbs with an intensity of 1000 lux for 12 h a day. The culture room was constantly wet to maintain the required relative humidity (75±5%). The cultures were irrigated by spraying water once or twice a day.

Result and Discussion

The effect of some cellulosic wastes on the growing periods and product yield of *P. florida* is shown in Table 1-2. Oyster mushroom, *P. florida* was cultivated on various residues for about 75 days, during which three fleshings were made (see Table 2).

Figure 1. *P. florida* primordium

Figure 2. Basidiocarp of *P. florida*

The mycelium growing period was 15.8±0.5 d, first primordia initiation (Figure 1) was 27.8±1.3 d, first harvest days was 35.3±0.5 d, the first yield was 265.5±31.4 g, second primordia initiation was 47.3±8.8 d, second harvest days was 52.5±7.4 d, the second yield was 61.1±34.3 g, third primordia initiation was 67.5±7.5 d, third harvest days was 73.5±7.5 d, the third yield was 27.3±11.8 g, and total yield was 353.9±20.1 g per 1000 g of material (70% moisture) (see Table 1-2, Figure 2).

Table 1. Effect of various residues on growing periods of *P. florida* (days).

Mycelium growing days	first primordia initiation	first harvest days	second primordia initiation	second harvest days	third primordia initiation	third harvest days
15.8±0.5	27.8±1.3	35.3±0.5	47.3±8.8	52.5±7.4	67.5±7.5	73.5±7.5

Table 2. Effect of various residues on yield of *P. florida* (g/kg).

First Yield	Second Yield	Third Yield	Total Yield
265.5±31.4	61.1±34.3	27.3±11.8	353.9±20.1

In *Pleurotus* spp. the primordial initiation was generally observed on day 20-90 (Khanna et al., 1992; Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003; Akyuz and Yıldız, 2008; Kırbag and Akyüz, 2008ab; Atilla, 2017ab), total harvest period was observed on the 30-108 days (Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003; Akyuz and Yıldız, 2008; Kırbag and Korkmaz, 2013; Atilla, 2017ab), and total yield was determined as 9-43 g/100 g (Akyüz and Yıldız, 2008; Kırbag and Akyüz, 2008ab; Kırbag and Korkmaz, 2013; Atilla, 2017ab). The mentioned studies have reported various values for the mycelium growing days, primordium formation time and yield, which may have arisen from the biological structure of substrate used for the culture. In previous studies (Khanna et al., 1992; Ragunathan et al., 1996; Ragunathan and Swaminathan, 2003; Akyuz and Yıldız, 2008; Kırbag and Akyüz, 2008ab; Atilla, 2017ab), different locally available agricultural wastes were used as substrates for the culture of *Pleurotus* spp. Also mixed materials may be used in culture of mushrooms. Different results were obtained depending on the material in culture medium, structure of the compost and cultivation methods and techniques used for the culture.

Based on the results obtained, it was observed that the average yield of 35% was obtained by using 1:1 ratio of mixture of *M. sativa* and paper wastes.

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TRUFFLE CULTURE AND ITS FUTURE IN TURKEY

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ABSTRACT

Truffles (*Tuber* spp.) are edible hypogeous fungi that establish symbioses with roots of shrubs and trees. Because of their different unique aromas and flavor, they are a valuable food product with high economic value in the world cuisine. Truffles are not only a gourmet food but also a source of income for those who cultivate or collect them from the wild. Turkey is rich in truffle species due to its climatic conditions, unique geographical position, and the vegetation. *Tuber aestivum* Vittad. is becoming an important commodity of great economic value in Turkey as well as in some European countries. In our country, studies on truffle mushrooms have gained momentum in recent years. Currently, cultivated *Tuber aestivum* is becoming an important commodity of great economic value in Turkey. This study aimed to emphasize the state of truffle cultivation in Turkey and shed light on the future of truffle culture. The determination of the status of the truffle cultivation and ıts future aspects in Turkey was aimed in this study. İn order to artificial truffle forests the soil characteristics, climate and precipitation characteristics, will be taking into consideration oak, hazelnut, pecan seedlings grafted with truffle will be planted in the suitable areas for growing truffle species in Turkey. Studies on truffle have gained momentum in recent years in Turkey and Truffle Application and Research Centers were established, Three institutions can grow seedlings grafted with truffle in our country. Two of them are state institutions and one belongs to the private sector. A total of 38000 grafted seedlings were produced in the Denizli and Muğla Forest Region Directorate and Truffle Application and Research Center. Truffle orchard was established in 357 ha of land in Turkey by the General Directorate of Forestry. To identify the biodiversity of species truffle in Turkey, to raise public awareness, to create a new source of income for our rural people, to bring this wealth to the national economy, to inventory of natural truffle areas was prepared and a truffle action plan was put into action by General Directorate of Forestry in 2014-2019.

Key words: Truffle, Mushroom, *Tuber* spp, Turkey,

Introduction

Tuber species of the Ascomycetes class fungi that the fruiting bodies of hypogeous form ectomycorrhizae (ECM) with the roots of trees, such as oak, poplar, willow, hazel and shrubs, such as *Cistus* in Mediterranean conditions [Smith,1997; Fontana et all (1978–1979)]. *Tuber* (Pezizales, Ascomycota) genus produce hypogeous ascocarps, Truffles are expensive delicacies, traded globally that are served in the most prestigious restaurants all over the world (Hall et al. 2007). There are numerous European *Tuber* species, but fewer than a dozen are sought for culinary use. The "Italian" white truffle (*Tuber magnatum* Picco) is the most valuable Old World truffle, The European black truffle (*Tuber melanosporum* Vittad.) is second; The other two species are the white bianchetto truffle (*Tuber borchii* Vittad.) and the Burgundy truffle (*Tuber aestivum* Vittad. or *T. uncinatum* Chatin). Truffle, whose quality varies between 200 euro and 3000 euro, is a very profitable production for farmers (Chevalier and Frochot, 1997, Duell, 2012).

Over the last few decades, the production of some truffle species, such as *T. melanosporum*, in Europe has declined rapidly, mainly as a result of overexploitation and the disruption of their natural habitat (Hall et al., 2001, 2003). Because of this decline, seedlings that have been inoculated with the spores of truffles have been produced and cultivated in specialized orchards. Old World truffles are adapted to European trees such as the common hazel (*Corylus avellana* L.), holly oak (*Quercus ilex* L.) and downy oak (*Quercus pubescens* Willd.), so they are inoculated onto seedlings of these species. After

the tree seedling is planted in an orchard, the fungus grows from the mycorrhizal root tips into the surrounding soil, where it must compete with local mycorrhizal fungi. Traditionally, Italy and France have been the pioneers of truffle cultivation and marketing (Donnini et al. 2013; Zambonelli et al. 2014). Truffles form ectomycorrhizae (ECMs) (Trappe, 2005) and nowadays many commercial nurseries supply mycorrhizedseedlings obtained by inoculating tree seedlings with Tuber-spore inocula. Worldwide, different *Tuber* species are cultivated by planting *Tuber*-mycorrhized seedlings. The production of plants mycorrhized with *T. melanosporum*., *T. aestivum*., *T. borchii*. and *T. macrosporum* Vittad. is a routine practice in nurseries (Olivier 2000; Benucci et al. 2012). The cultivation of *T. melanosporum* is the most common worldwide. Examples of successful cultivation are present in its native area of growth, mainly Italy, France, and Spain, as well as in New Zealand, North America, Australia, South Africa (Reyna and Garcia-Barreda 2014). Truffle production is influenced by a number of biological and ecological factors that span from the quality of the truffle-inoculated seedling (e.g., mycorrhization level, a well-formed root system, age, health status) to the characteristics of the plantation site (e.g., soil and climatic conditions, altitude, orientation, previous land use). Therefore, the two fundamental prerequisites for successful truffle-farming are the selection of the plantation site and the quality of the truffle-inoculated seedling (Bencivenga and Baciarelli Falini 2012; Olivier et al. 2012; Reyna 2012; Murat 2015). Truffle growers know that many factors may alter the presence of truffle ectomycorrhizae and influence truffle production. Some factors are mainly environmental, such as: (1) exceptional weather events (e.g., thunderstorms, floods, landslides); (2) the presence of wild animals like boars and rodents (Zotti et al. 2013; Zambonelli et al. 2016), which may disturb the establishment of the mycorrhized trees in young plantations; and (3) the presence and distribution of truffle mating-type in the soil (Taschen et al. 2016). Other factors may be related to incorrect cultivation practices, like irrigation, soil management, pruning techniques etc. (Bencivenga and Baciarelli Falini 2012).

Productive truffle orchards in France, Italy and Spain presently provide rural landowners with an alternative to agricultural subsidies, promote restoration of abandoned cereal lands and require relatively low agricultural inputs (Samils et al., 2003). More recently, truffle plantations have been installed in New Zealand, Australia, Israel and North America with production reported from New Zealand and North America (Lefevre and Hall, 2001).

This study aim is to provide an update in the recent truffle cultivation research, developments in our country.

Materials and methods

The developments of truffle cultivation, which the current situation has been achieved and the knowledge needed for its progress are reviewed. The research proceedings relied upon research article and data which is puplic and private institution directions. The data constituting (collected) our research material was obtained from public and private institutions and organizations engaged in truffle cultivation in our country.

Findings

Turkey is located as a bridge of the European and Asian flora and in the Mediterranean belt where the countries have rich truffle biodiversity and it shows high biodiversity of ectomycorrhizal fungi such as truffles. Twenty-three genus and 15 families belonging to 67 truffle taxa have been determined in Turkey so far (Oder, 1988**;** Isiloglu and Oder 1995**;** Afyon, 1996; Doğan and Öztürk, 2006; Solak et al., 2007**;** Kaya, 2009**;** Castellano and Turkoglu, 2012**;** Turkoglu and Castellano, 2014**;** Turkoglu et al.**,** 2015; Sen et al., 2016). *T. aestivum* is one of these and spreads in Antalya, Artvin, Bolu, Burdur, Denizli, Düzce, Hatay, Istanbul, Izmir, Muğla, Kırklareli, Ordu, Osmaniye in Turkey (Sen et al., 2016). There are many potential activities and initiatives identified for the continued development of the truffle sector in Southwest Turkey and future opportunities for collaboration between experts from Turkey. The cultivation of *T. aestivum* is drawing increasing interest from farmers for several reasons in Turkey. Due to the biological and ecological factors is enough to cultivate *T. aestivum*, which is the most economically important truffle spp. in Turkey. Plantations begin *T. aestivum* within 4 years but typically production begins 6–10 years after inoculated seedlings.

When the Truffle Application and Research Centers were established (since 2015), studies on truffle-grafted seedlings, truffle morphological and molecular identification and reporting, and mycorrhizal reporting of truffle seedlings have started.

In order to use the land more efficiently in truffle gardens under suitable land conditions, species such as Lavender, which do not harm the development of truffle fungus, can be grown in our country.

Three institutions can grow seedlings grafted with truffle in our country. Two of them are state institutions and one belongs to the private sector. A total of 38000 grafted seedlings were produced in the Denizli and Muğla Forest Region Directorate and Truffle Application and Research Center. Truffle orchard was established in 357 ha of land in Turkey by the General Directorate of Forestry. To identify the biodiversity of species truffle in Turkey, to raise public awareness, to create a new source of income for our rural people, to bring this wealth to the national economy, to inventory of natural truffle areas was prepared and a truffle action plan was put into action by General Directorate of Forestry in 2014-2019.

Discussion and Conclusions

Truffles, both native and cultivated, help to urban and rural communities through the food system, as they have for centuries in the cultural life and market systems of Europe (especially Italy and France). Truffle cultivation cost-benefit analyses differ widely among countries (Bonet and Colinas, 2001), results from successful plantations have stimulated a rising international interest where adequate or amendable ecological conditions exist. Truffle cultivation requires long-term investments and promotes stability in the agricultural and socio-economic environments. Anticipated long-range returns on investment are higher than those of virtually any other agricultural enterprise. Although estimating future demand is highly uncertain, organizing training on truffle culture and hunting will contribute to the economy of the country by recognizing and protecting the truffle mushrooms and providing an alternative agricultural practice with high returns especially to the rural people living in rural areas. Indirect or derivative economic benefits contribute the truffle industry such as suppliers of farm equipment, buyers, seedling producers, lime and fertilizer suppliers, irrigation suppliers, farm laborers, accountants, marketing specialists, lawyers, and business owners, managers, product producers, brokers, exporters, retailers, restaurateurs, chefs and tourism providers etc. Given the estimates of potential market value in Turkey, we anticipate that truffles could become industry that is directly worth hundreds of millions of dollars annually to farmers, small woodlot owners and harvesters. There are no data on how many truffle are actually consumed in Turkey demand and production are not but in an economy where truffles compete globally, these factors may converge.

This study provides detailed information on situation of the cultivation truffle species and enhance the state's native truffle industry in Turkey. The study concludes by detailing the steps needed to create a world-class truffle industry in Turkey.

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ISOLATION, IDENTIFICATION OF YEASTS FROM OIL CONTAMINATED SOILS AND DETERMINATION OF ORGANIC SOLVENT TOLERANCE

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ABSTRACT

Organic solvents are toxic to many microorganisms. Some microorganisms are not affected by this toxicity. Microorganisms not affected by toxic solvents have potential applications in bieromidiation and industrial areas. In this study, it is aimed to isolate, identify and determine minimum toxic solvent amount of yeast species resistant to various organic solvents from oil polluted areas around İzmir. In this study hexane, heptane, cyclohexane and toluene were used as organic solvents. 25 isolates were obtained as a result of isolation. It was determined that the isolates were *Candida tropicalis, Torulaspora delbrueckii, Pichia kudriavzevii, Geotrichium candidum, Debaryomyces hansenii* species. The resistance of the isolates to the organic solvents (5%, 10%, 20%) of toluene, n-heptane, n-hexane and cyclohexane was tested. The reproduction results were measured spectrophotometrically and evaluated. The organic solvent resistance was also tested by disc diffusion and spotting in the solid medium. As a result of the tests, it was found that all of the isolated species showed growth in all solvent values in liquid medium. In the tests carried out on solid media, the resistance of the species to solvents was found to be different. Except for *Pichia kudriavzevii* strains, all yeasts were found to be resistant to hexane and heptane. Only *Torulaspora delbrueckii* strain was found to be resistant to cyclohexane solvent. In the toluene test, no organism was able to grow.

Key words: Organic solvent, yeast, resistance

Petrolle Kontamine Topraklardan Mayaların İzolasyonu, İdentifikasyonu Ve Organik Solvent Toleransının Belirlenmesi

ÖZ

Organik solventler birçok mikroorganizma için toksik etki göstermektedir. Bazı mikroorganizmalar bu toksisiteden etkilenmemektedir. Toksisiteden etkilenmeyen mikroorganizmalar bieromidiasyon ve endüstriyel alanda potansiyel kullanım alanına sahiptir. Bu çalışma içerisinde de izmir civarında petrol ile kirlenmiş bölgelerden çeşitli organik solventlere karşı dirençli maya türlerinin izolasyonu, identifikasyonu ve minimum toksik solvent miktarının belirlenmesi amaçlanmıştır. Çalışma içerisinde organik solvent olarak hexan, heptan, siklohegzan ve tolüen kullanılmıştır. İzolasyon sonucunda 25 izolat elde edilmiştir. ITS1-4 primerleri kullanılarak yapılan identifiksayonda İzolatların Candida tropicalis, *Torulaspora delbrueckii, Pichia kudriavzevii, Geotrichium candidum, Debaryomyces hansenii* türleri olduğu belirlenmiştir. Tanısı yapılan izolatların toluen, n-heptan, n-hekzan ve siklohexan gibi organik solventlere(%5, % 10, %20) karşı dirençleri test edilmiştir. Elde edilen üreme sonuçları spektrofotometrik olarak ölçülüp , değerlendirilmiştir. Organic solvent direnci ayrıca katı besiyeri içerisinde disk difizyon ve spotlama yöntemiylede test edilmiştir. Yapılan testler sonucunda izole edilen türlerin tamamı, sıvı ortamdaki solvent değerlerinin hepsinde üreme gösterdiği bulunmuştur. Katı ortamlarda yapılan testlerde türlerin solventlere

karçı dirençleri değişkenlik göstermektedir. *Pichia kudriavzevii* türleri haricinde bütün mayaların hexan ve heptana karşı dirençli olduğu saptanmıştır. Sikloekzan solventine karşı ise sadece *Torulaspora delbrueckii* izolatı dirençli olarak saptanmıştır. Tolüen testinde ise hiçbir organizma üreyememiştir.

Anahtar kelimeler: organik solvent, maya, direnç

Introduction

Organic solvents are derived from petroleum and natural gas. The presence of at least one carbon and hydrogen atom in their structure is low-molecular pain and lipophilic in volatile liquid at room temperature. Organic solvents with a wide chemical spectrum have found widespread use in recent years as a result of industrial developments. Organic solvents are used in many substances such as gasoline, diesel oil, heating oil, adhesives, paint solvents, thinners, aerosols, oil removers, cosmetics. people are exposed to these substances in daily life, albeit unnoticed. In addition, in many industrial areas, chemical reactions take place in organic solvents(Goulart et al.,2014). There is a need for microorganisms or various enzymes that may exhibit biocatalytic activity in these solvents(NA et al.,2005; Nıshıda, 2014; Shafiei et al.,2011). However, organic solvents cause toxic effects for microorganisms. The accumulation of toxic organic solvents in the membrane increases membrane fluidity and membrane swelling, impairing the normal function of membrane-associated proteins and ultimately leading to cell death. It has been reported in many studies that the toxicity of solvents is related to the logp value. LogP serves as an indicator of the extent to which solvents are absorbed by plants, animals, humans or other living tissues. Solvents with a LogP value between 1 and 5 are generally reported to be toxic(Isken et al.,1998). As this value approaches 1, toxicity increases. However, some microorganisms may be tolerant to these toxic solvents. Microorganisms react in a variety of ways to toxic solvents. The solvent entering the cell through the synthesis of various transporter proteins can be discharged out of the cell by means of flow pumps in the membrane. In addition, stress mechanisms such as altering the cell surface permeability and reducing the solvent transfer or making the solvent entering the cell less toxic by various metabolic pathways come into play(Kurtzman et al.,2011;Isken et al.,1998). In addition, some organisms may use such organic solvents as carbon sources. In particular, *Pseudomonas putida, Pseudomonas aeroginosa, E.coli, Bacillus sp. Flavobacterium sp. and Arthrobacter sp.* are resistant to organic solvents such as cyclohexane, xylene, heptanol toluene, benzene chloroform(Aono et al.,1995; Sardessai et al.,2004). However, there are not many studies and findings about yeasts. *Candida sp. and Saccharomyces sp.* genus species have been shown to be resistant to organic solvents in eukaryotic microorganisms such as yeast(Fukumaki et al.,1994; Filipowicz et al.,2017; Tikka et al.,2013). In this study, it is aimed to isolate, identify and determine the minimum amount of toxic solvent in yeast species resistant to various organic solvents.

Material and Method

Isolation and identification

Yeast isolations were made from oil contaminated soil samples. 5 g of soil samples were made by dilution and inoculated into malt yeast glucose peptone (MYGP) agar medium. Samples were inoculated at 27 degrees for 3 days. Colonies that developed after incubation were selected and purified according to their morphology. Isolation, purification and resistance tests of organic yeasts were carried out on Malt yeast glucose peptone (MYGP) medium. ITS1 (5'-TCC GTA GGT GAA CCT GCG G-3 ') and ITS4 (5'-TCC TCC GCT TAT TGA TAT GC-3') primers were used for the amplification of the ITS region in the molecular identification of the isolated yeasts. The conditions and quantities of materials proposed by Leaw(2006). Sequence analyzes of the samples from the amplified ITS PCR products were performed using the Sanger method. Sequences obtained from sequence analysis were compared with the Basic Local Alignment Search Tool (BLAST) program in the NCBI database. The obtained sequences were plotted phylogenetic tree using MEGA X phylogenetic software.

Organic solvent resistance

The resistance of the obtained isolates to toluene, n-hexane, n-hepan and cyclohexane solvents was performed in 96 well wells. After isolating the isolates, 5%, 10%, 20% hexane, heptane, cyclohexane and toluene were added from each

solvent. The samples were allowed to incubate at 27 degrees for 5 days. After incubation, it was measured with a 660 nm spectrophotometer. wells with yeast growth were positive.

Disc diffusion test

The yeast isolates were inoculated into mygp medium and sterile discs of 5 micrometer size were placed. 5 microliters of pure organic solvents (hexane, heptane, cyclohexane, toluene) were injected into the placed discs. After the samples were incubated at 27 degrees for 2 days, zone formation was checked.

Determination of organic solvent tolerance on solid medium

Spot cultivation of isolates were carried out on glass oils containing MYGPA medium. N-heptane, n-hexane, cyclohexane, toluene were applied onto the cultivated medium by spoting the surface of the petri dish to cover 2 cm. After 10 days in a 27 ° C incubator, which organisms were observed to grow (Hayashi et al., 2003).

Results

25 isolates were obtained as a result of the isolation. The fragments obtained from the ITS gene regions of the isolates obtained by PCR were sequenced by sanger method. The base sequences obtained as a result of the sequence were evaluated using the blast program in the NCBI database. As a result of the evaluation, *Candida Tropicalis, Torulaspora Delbrueckii, Pichia Kudriavzevii, Geotrichium Candidum and Debaryomyces Hansenii* species were determined. It is seen that similar species obtained from the phylogenetic analysis are clustered in the same branch(Figure 1).

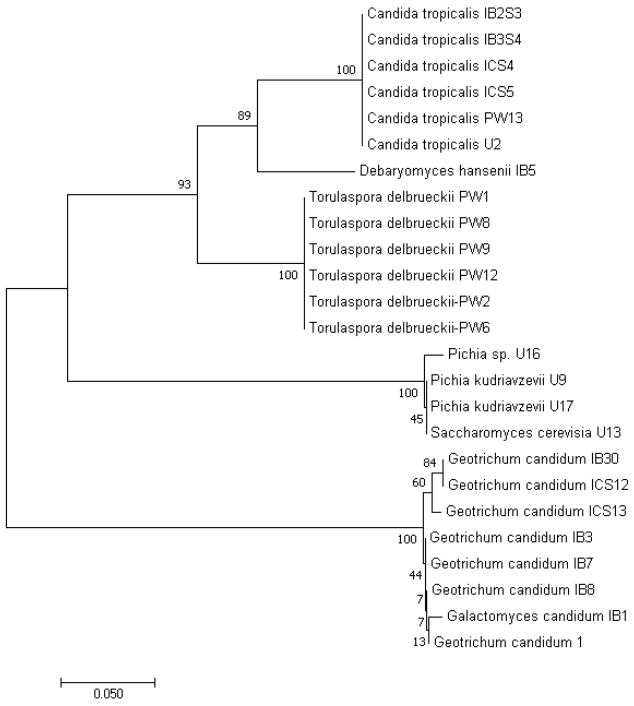

Figure 1:Phylogenetic tree drawn with its gene region data

The growth of the identified species in different concentrations in the mygp medium is detailed in the table(Figure2). All of the obtained species showed growth against hexane, heptane, cyclohexane and toluene solvents at concentrations of

10%, 20%, 30%. The growths in toluene were weak compared to other solvents. Torulaspora delbrueckii species showed more intense growth in toluene solvent than other species.

The organisms were controlled directly by adding 5 microliters of solvent using disc diffusion technique. All species obtained produced no zone against hexane, heptane, cyclohexane solvent. However, it was observed that 7 mm zones formed around the discs injected with toluene.

Another experiment was carried out by pouring pure solvents directly onto the organisms which were spotted on solid mypg medium in glass petri dish. In this experiment, only *Pichia kudriavzevii* strains in hexane and heptane solvents did not show growth. All the other species obtained showed growth against hexane and heptane solvent. Only the PW1 strain of *Torulaspora delbrueckii* was able to grow in the cyclohexane solvent. In the toluene solvent, no species of strains were able to grow.

Discussion

Although many of the organic solvents show toxic effects for microorganisms, some microorganisms in nature can overcome such stress conditions through various adaptations. The logp value, which is considered as a toxic criterion of organic solvents, has been shown in many studies. In particular, solvents with a logp value of 1-5 are considered toxic(Aono et al.,1995; Nielsen et al.,2005). The solvents identified in the study were selected from these logp values.

As stated in the findings, 25 isolates were obtained in the study. In the identification analysis according to the Its gene region, the species were identified as *Candida tropicalis, Torulaspora delbrueckii, Pichia kudriavzevii, Geotrichium candidum, Debaryomayces hansenii*. Various solvent experiments on the species gave different results. In the experiments carried out on liquid mypg medium, all organisms showed growth and were not affected by the toxic effects of solvents. Although the growth in toluene, which is the most toxic in the solvents, was poor, especially *Torulaspora delbrueckii* species grew intensely. Some organisms have grown more intensively in hexane and heptane solvents than solvent free environment. This suggests that the organism may use the solvent as a carbon source. These supply organisms are thought to be effective microorganisms, even in the presence of organic solvents, especially in processes based on liquid fermentation.

In the experiments using disc diffusion and spot technique, the direct effect of isolated yeast species on organic solvents was examined. All of the species obtained by disc diffusion method did not form zones against hexane, heptane and cyclohexane. Toluene the most toxic solvent, produced a zone of 7mm diameter as expected. The results were different in direct 2 cm solvent treatment. While no zones were observed in the disc method, *Pichia kudriavzevii* species did not grow in hexane and heptane. In the cyclohexane, only *Torulaspora delbrueckii* species were able to grow Direct pouring test had more effect on yeast strains than disc diffusion test. The number of yeast strains that could not develop in this method increased due to the higher solvent concentrations. In the experiment with toluene solvent, no organism was able to grow. As a result of the experiments, it was seen that most of the organisms are not affected by solvents with a logp value close to 5 such as hexane and heptane. It has been observed that as the amount of these solvents increases, especially the growth of *Pichia kudriavzevii* strains weakens. However, solvents with a logP value closer to 1, such as cyclohexane and toluene, have a high toxic effect. Although the toxicity of cyclohexane and toluene solvents in the liquid medium up to a certain concentration is low, the isolates cannot grow in case of direct exposure in the solid medium. The main reason why the toxicity in the liquid medium is less than the solid environment is that the solvents are not fully soluble in the medium. As a result, it was determined that the most resistant organism group were strains belonging to Torulaspora delbrueckii species.

According to the studies, *Candida* genus species (such as *C. maltosa, C. sake and C. tropicalis*) have been reported to tolerate some organic solvents with low logP values such as n-octane and isooctane, but the species of *Saccharomyces* and *Williopsis* species have not been tolerated. *Torulaspora species* can be isolated from many places and there are studies that are resistant to various stress conditions in general. However, since species belonging to the genus *Torulaspora* are used in the production of alcoholic beverages, such as wine, studies have generally been conducted on ethanol stress(Ramírez et al.,2018).

	strain	species	Hexane (logP:3,5) %10	%20	%30	D	P	Heptane (logP:4,0) %10	%20	%30	D	P	Cyclohexane(logP:3,4) %10	%20	%30	D	P	Tolüen(logP :2,5) %10	%20	%30	D.	P
1	IB2S3	*Candida tropicalis*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
2	IB3S4	*Candida tropicalis*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
3	ICS4	*Candida tropicalis*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
4	ICS5	*Candida tropicalis*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
5	U2	*Candida tropicalis*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	
6	PW13	*Candida tropicalis*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
7	PW1	*Torulaspora delbrueckii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	+	+	+	+	Z	-
8	PW8	*Torulaspora delbrueckii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
9	PW9	*Torulaspora delbrueckii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
10	PW12	*Torulaspora delbrueckii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	
11	PW2	*Torulaspora delbrueckii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
12	PW6	*Torulaspora delbrueckii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	
13	IB5	*Debaryomyces hansenii*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
14	U16	*Pichia kudriavzevii*	+	+	+	N	-	+	+	+	N	-	+	+	+	N	-	+	+	+	Z	-
15	U9	*Pichia kudriavzevii*	+	+	+	N	-	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
16	U17	*Pichia kudriavzevii*	+	+	+	N	-	+	+	+	N	-	+	+	+	N	-	+	+	+	Z	-
17	U13	*Pichia kudriavzevii*	+	+	+	N	-	+	+	+	N	-	+	+	+	N	-	+	+	+	Z	-
18	IB30	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
19	ICS12	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
20	ICS13	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
21	IB3	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
22	IB7	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
23	IB8	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-
24	IB1	*Geotrichium candidum*	+	+	+	N	+	+	+	+	N	+	+	+	+	N	-	+	+	+	Z	-

Figure 2: Organic solvent resistance test results. D: disc diffusion test , P:pure solvent poured directly on to the spotted organnisms, N: no zon, Z: there is zone (7-8mm),

Determination of the solvent resistance of these organisms is beneficial in many respects. Degradation of the toxic solvent released into the environment in various ways by these organisms may be a potential means of preventing solvent pollution. Another effect can be seen in the industrial field. Various enzymes are needed today in many chemical processes. The enzymes of these organisms can work under extreme conditions. Lipase production of yeasts resistant to organic solvents was investigated in some studies. Similarly, many enzymes can be obtained from such organisms(Peng et al.,2016). Furthermore, the enzymes obtained can be improved by genetic engineering in different properties.

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BIOLOGICAL ACTIVITY POTENTIALS OF *AMANITA* SPECIES

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ABSTRACT

Mushrooms have played an important role in human activities because of their different characteristics from past to present. Mushrooms are widely consumed because they are functional food and an important part of low calorie diets. In addition to the nutritional properties, both inedible and poisonous mushrooms have significant medicinal properties due to secondary metabolites they produce. The genus *Amanita* is one of the best known genera in the Agaricales ordo. *Amanita* members, which are distributed worldwide cosmopolitan, contain edible and poisonous mushroom. In this study, biological activity potentials of *Amanita* members were investigated. As a result of literature researches, *Amanita* species have been reported to have antioxidant, antibacterial, antifungal, antiviral, anticancer, antitumor, anti-inflammatory, pesticidal activity, anti-acetylcholinesterase, larvicidal, esterolytic activity and cytotoxic properties. In this context, it was determined that *Amanita* genus, which contains edible and poisonous species, has many biological activities. It is thought that *Amanita* genus which has important effects in terms of biological activity may be an important natural agent in pharmacological designs.

Key words: Agaricales, Alternative medicine, *Amanita*, Biological Activity

Introduction

Mushrooms have played an important role in human activities because of their different characteristics from past to present (Sevindik et al., 2016). *Amanita* Pers. genus (Amanitaceae/Agaricales) is a cosmopolitan genus that can spread in many parts of the world and contains 500 species (Wartchow, 2017). *Amanita* is common in the world and is eaten, poisonous and contains mushroom known to have hallucinogenic properties. Historical evidence suggests that at least three Roman emperors and one Pope may be among the victims of fungal poisoning. *Amanita* genus is responsible for about 90% of poisoning from mushroom consumption in many parts of the world (Kirk et al., 2008). This genus contains extremely poisonous *A. phalloides*, edible mushroom *A. caesarea* and hallucinogenic *A. muscaria* species. In this study, biological activities of *Amanita* genus members were reviewed.

Bioactive Compounds

Mushrooms are produce many metabolic compounds in their bodies (Bal et al., 2017). Secondary metabolites of these compounds are responsible for many biological activities (Sevindik et al., 2018). In previous studies, members of the genus *Amanita* have been reported in contain phenolic compounds such as cinnamic acid, ferulic acid, p-coumaric acid, soycerebroside I, β-amanitin, phalloin, α-amanitin, phalloidin, gallic acid, catechin, caffeic acid, protocatechuic acid, ρ-hydroxybenzoic acid, benzoic acid, chlorogenic acid, salicylic acid, oxalic acid, citric acid, ketoglutaric acid, malic acid, quinic acid, succinic acid, shikimic acid and fumaric acid. (Kim et al., 2008; Ribeiro et al., 2008; Doğan, 2013; Nowacka et al., 2015; Kouassi et al., 2016; López-Vázquez et al., 2017).

Biological Activity

In this study, biological activities of *Amanita* species are given in literature. The findings obtained from the literature researches are shown in Table 1.

Table 1. Biological Activities of *Amanita* species

***Amanita* species**	**Biological Activities**	**References**
A. afrospinosa	Antioxidant	Fadeyi et al.,2019
A. augusta	Antiproliferative, Immunostimulatory, Anti-Inflammatory	Deo et al., 2019
A. caesarea	Antioxidant, Antimicrobial,	Yamaç and Bilgili, 2006; Sarikurkcu et al., 2010; Reis et al., 2011; Tripathy et al., 2014; Sharma and Gautam, 2015; Dimitrijevic et al., 2015; Zhu et al., 2016; Yıldız et al., 2017; Li et al., 2017; López-Vázquez et al., 2017; Salihović et al., 2019
A. calyptroderma	Antibacterial	Srikram et al., 2018
A. ceciliae	Antioxidant,	Akata et al., 2012
A. citrina	Antioxidant, Cytotoxic activity, Antibacterial	Lutsik-Kordovsky et al., 2001; Sharma and Gautam, 2015; Nowacka et al., 2015; Adeoyo et al., 2016
A. cokeri	Antibacterial	Drehmel and Chilton, 2002
A. crassiconus	Antioxidant	Fadeyi et al.,2019
A. craseoderma	Antioxidant	Fadeyi et al.,2019
A. flavella	Antibacterial	Bala et al., 2011
A. fulva	Antioxidant	Sharma and Gautam, 2015
A. foetens	Antibacterial	Dighe and Agate, 2000
A. loosei	Antioxidant	Rajoriya and Gupta, 2015; Fadeyi et al.,2019
A. masasiensis	Antioxidant	Fadeyi et al.,2019
A. muscaria	Antioxidant, Pesticidal Activity, Larvicidal Activity, Cytotoxic activity, Antibacterial, anticancer, Anti-inflammatory	Lutsik-Kordovsky et al., 2001; Reis et al., 2011; Ruthes et al., 2013; Chelela et al., 2014; Cárcamo et al., 2016; Masota et al., 2017; Carapeto et al., 2017; Ivashchenko et al., 2018
A. nana	Antibacterial	Al-Fatimi et al., 2005
A. ochrophylla	Antibacterial	Bala et al., 2011

Table 1. Continue

A. ovoidea	Antioxidant	Dogan, 2013; Doğan ve Arslan, 2015
A. odorata	Antioxidant	Fadeyi et al.,2019
A. pantherina	Antioxidant, Antibacterial	Reis et al., 2011; Nowacka et al., 2015
A. phalloides	Antioxidant, enzyme activity, Antitumor, Antimicrobial, Cytotoxic activity	Lutsik-Kordovsky et al., 2001; Zheleva et al., 2004; Riede, 2013; Chelela et al., 2014; Pišlar et al., 2016; Riede, 2016; Erjavec et al., 2016; Lukanc et al., 2017;
A. porphyria	Antibacterial	Nowacka et al., 2015
A. princeps	Antibacterial	Srikram et al., 2018
A. pulverulenta	Antioxidant	Fadeyi et al.,2019
A. rubescens	Antioxidant, Antimicrobial, Cytotoxic activity	Lutsik-Kordovsky et al., 2001; Ribeiro et al., 2008; Keleş et al., 2011; Kosanic et al., 2013; Kouassi et al., 2016
A. spissacea	Cytotoxic activity	So et al., 2019
A. strobiliformis	Antioxidant, Anti-Acetylcholinesterase	Karaman et al., 2018
A. subviscosa	Antioxidant	Fadeyi et al.,2019
A. subjunquillea	Cytotoxic activity	Kim et al., 2018
A. xanthogala	Antioxidant	Fadeyi et al.,2019
A. vaginata	Antioxidant, Antimicrobial, esterolytic activity	Ertunga et al., 2009; Giri et al., 2012; Paloi and Acharya, 2013; Singha et al., 2017
A. virgineoides	Antiviral	Liu et al., 2017
A. virosa	Cytotoxic activity, Antimicrobial	Lutsik-Kordovsky et al., 2001; Antonyuk et al., 2010
A. zambiana	Antibacterial	Reid et al., 2016

Conclusion

Mushrooms have many therapeutic properties as well as their nutritional properties. In this study, biological activities of *Amanita* genus which contains edible, poisonous and hallucinogenic properties are emphasized. As a result of literature researches, it was determined that *Amanita* members exhibited important biological activities. In this context, it was determined that species belonging to genus *Amanita* can be evaluated in pharmacological studies.

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DETERMINATION OF HEAVY METAL CONCENTRATIONS IN SOME WILD MUSHROOMS OF *STROPHARIACEAE* FAMILY

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ABSTRACT

In this study, It was determined using ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry) spectrometry that the heavy metal (Al, As, Cd, Co, Cu, Cr, Fe, Mg, Mn, Ni, Pb, Se, and Zn) ion contents of some *Strophariaceae* family mushroom samples, which were collected within the borders of Çorum province.

Ten element contents were analyzed in six wild species of *Strophariaceae* family [*Agrocybe dura* (Bolton) Singer, *Cyclocybe cylindracea* (DC.) Vizzini & Angelini, *Hypholoma fasciculare* (Huds.) P. Kumm., *Pholiota lenta* (Pers.) Singer, *Pholiota limonella* (Peck) Sacc., *Stropharia rugosoannulata* Farl. ex Murrill] from Çorum region of Turkey by using ICP-OES.

After the analysis, the lowest and highest values for aluminum ion were determined respectively in *Pholiota limonella* (10.69 mg/kg) and *Stropharia rugosoannulata* (2607 mg/kg) fungi. Similarly, for the Fe ion, *Pholiota limonella* (29.19 mg/kg) and *Stropharia rugosoannulata* (7629 mg/kg) were found respectively. Among all fungi, the lowest and highest values for Mn ion were found in *Hypholoma fasciculare* (12.79 mg/kg) and *Stropharia rugosoannulata* (325.7 mg/kg). For Zn ion were detected respectively in *Stropharia rugosoannulata* (39.47 mg/kg) and *Agrocybe dura* (120.0 mg/kg) fungi.

Key words: *Strophariaceae*, ICP-OES, heavy metals, ions, Çorum.

Strophariaceae Familya'sından Bazı Yabani Mantarlarda Ağır Metal Konsantrasyonlarının Belirlenmesi

ÖZ

Bu çalışmada ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry) spektrometresi kullanılarak Çorum ili sınırları içerisinde toplanan bazı *Strophariaceae* familyasına ait mantar örneklerinin ağır metal (Al, As, Cd, Co, Cu, Cr, Fe, Mg, Mn, Ni, Pb, Se ve Zn) iyon içerikleri belirlenmiştir.

On elementin içeriği ICP-OES kullanarak Türkiye'nin Çorum bölgesinden toplanan altı doğal *Strophariaceae* familyası türünde [*Agrocybe dura* (Bolton) Singer, *Cyclocybe cylindracea* (DC.) Vizzini & Angelini, *Hypholoma fasciculare* (Huds.) P. Kumm., *Pholiota lenta* (Pers.) Singer, *Pholiota limonella* (Peck) Sacc., *Stropharia rugosoannulata* Farl. ex Murrill] analiz edildi.

Analizlerden sonra alüminyum iyon için en düşük ve en yüksek değerler sırasıyla *Pholiota limonella* (10.69 mg / kg) ve *Stropharia rugosoannulata* (2607 mg / kg) mantarlarında belirlenmiştir. Benzer şekilde, Fe iyonu için sırasıyla *Pholiota limonella* (29.19 mg / kg) ve *Stropharia rugosoannulata* (7629 mg / kg) bulunmuştur. Tüm mantarlar arasında, Mn iyonu için en düşük ve en yüksek değerler *Hyphoma fasciculare* (12.79 mg / kg) ve *Stropharia rugosoannulata* (325.7 mg / kg) olarak bulundu. Zn iyonu için sırasıyla *Stropharia rugosoannulata* (39.47 mg / kg) ve *Agrocybe dura* (120.0 mg / kg) mantarlarında tespit edildi.

Anahtar kelimeler: *Strophariaceae*, ICP-OES, Ağır metal, İyonlar, Çorum

Introduction

Mushrooms, like other living things, cannot produce metal ions themselves. It is known that the major mushroom species in nature accumulate high amounts of heavy metals, mainly cadmium, mercury and lead (Kalac ve Svaboda, 2000).

Mushrooms absorb nutrients and metal ions directly or indirectly into the cell through their absorption properties and store them in high concentrations.

Therefore, it can be determined whether metal ions, which have harmful effects for human health cause heavy metal pollution in the work area.

In this study, by using species belonging to *Strophariaceae* family determined from different localities from Çorum Province;

It is aimed to:

1. Determination of heavy metal ion contents,
2. Comparison of previous studies in Turkey
3 Determine the possibility of evaluating fungi as bioindicators of environmental pollution.

Materials and Methods

Mushroom samples were collected from different localities from Çorum Province during the field studies conducted between 2011-2013. Respectively, the samples were first photographed. Then, it was removed from the substrate or soil with a suitable tool without damaging its morphological structure. At the same time, specific morphological information, habitat, altitude, GPS coordinates and photo numbers taken were noted.

Together with a small note with this information, the collected mushroom specimen was wrapped in suitable sized aluminum foil and brought to the fungaryum laboratory without damage.

Samples were examined under a microscope (DM 1000 imaging system) and identified using the appropriate literature (Breitenbach & Kränzlin, 1995; Dahncke, 1993; Noordeloos, 2011).

In Table 1, the code given to the fungi used in the study, the Latin name of the fungus, GPS coordinates, habitats and the district where it is collected are given.

Table 1. Mushrooms

Mushroom code	Mushroom	GPS coordinate	Habitat	Place of collection
M1	***Agrocybe dura*** (Bolton) Singer	40°45'12 North 034°25'21 East	Willow, Poplar mixed field, on soil	İskilip
M2	***Cyclocybe cylindracea*** (DC.) Vizzini & Angelini	40°32'25 North, 035°12'49 East	Poplar field, on stump	Mecitözü
M3	***Hypholoma fasciculare*** (Huds.) P. Kumm.	41°14'49 North 034°41'21 East	Pine, Fir, Beech mixed forest, on stump	Kargı
M4	***Pholiota lenta*** (Pers.) Singer	40°45'51 North 034°16'27 East	Pine, Fir Forest, on soil	İskilip
M5	***Pholiota limonella*** (Peck) Sacc.	40°45'51 North, 034°16'27 East	Pine, Fir forest, on stump	İskilip
M6	***Stropharia rugosoannulata*** Farl. ex Murrill	41°04'45 North 034°23'17 East	Oak, Pine mixed forest, on soil	Kargı

The dried samples of the fungi were washed with ultra-pure water, dried at 80 ° C for 10 hours and pulverized. 1 g of powder sample was taken into the Teflon cells of the microwave and 18 mL of HNO_3 and 2 mL of H_2O_2 were added.

After the gas was left in the fume hood for 5 minutes, the Teflon cells were closed and the solution was carried out at 1800 watt at 200 ° C for 15 minutes in the microwave. After cooling the Teflon cells, the addition of pure water

to a total volume of 25 ml was completed. Determination of minimum and maximum heavy metal contents for mushroom samples were performed by taking measurements in ICP-OES (Akın et. all., 2019).

With these measurements, a total of 12 heavy metal ions (Al, As, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Se, Zn) were determined in the fungi.

Results

The average heavy metal concentrations of the fungi used in this study are given in Table 2 in mg / kg-1 (taking into account the dry weight of the fungus).

Table 2. Metal Contents of Fungi

Mushroom code	Heavy metals (mg/kg)											
	Al	As	Co	Cr	Cu	Fe	Mg	Mn	Ni	Pb	Se	Zn
M1	1120	0,318	0,639	3,370	50,19	973,2	1713	24,06	n.d.	0,481	1,375	120
M2	1698	0,369	0,855	5,864	45,59	1500	1887	56,14	n.d.	0,823	0,023	116,5
M3	14,73	n.d.	0,367	0,69	72,35	51,96	901,8	12,79	n.d.	0,384	0,913	56,83
M4	250,7	0,029	0,142	1,371	25,57	367,1	1309	17,82	n.d.	0,73	0,321	65,92
M5	10,69	n.d.	0,036	0,578	13,56	29,19	1032	13,29	n.d.	0,141	0,324	56,91
M6	2607	n.d.	10,66	258,1	24,86	7629	n.d.	325,7	280	1,526	n.d.	39,47

Conclution

Pholiota limonella 10.69 mg / kg and *Stropharia rugosoannulata* 2607 mg / kg were the lowest and highest Al ion concentrations among the fungi used in this study (Figure 1).

Similarly, the lowest *Pholiota lenta* was 0.029 mg / kg and the highest *Cyclocybe cylindracea* was 0.369 mg / kg for As ion concentration (Figure 2).

In terms of the concentration of Co, Cr ions, the lowest *Pholiota limonella* was found to be 0.036 mg/kg - 0.578 mg/kg and the highest *Stropharia rugosoannulata* 10.66 mg / kg to 258.1 mg / kg, respectively (Figures 3 and 4).

In terms of Cu ions concentration, the lowest *Pholiota limonella* was found in 13.56 mg / kg and the highest *Hypholoma fasciculare* was found in 72.35 mg / kg (Figure 5).

The lowest Fe concentration was obtained from *Pholiota limonella* and the highest *Stropharia rugosoannulata* mushroom samples (Figure 6).

The lowest Mg ion concentration was found to be *Hypholoma fasciculare* 901.8 mg / kg and the highest concentration was *Cyclocybe cylindracea* 1887 mg / kg (Figure 7).

Among the fungi, the lowest and highest Mn ion concentrations were calculated in *Hypholoma fasciculare* 12.79 mg / kg and *Stropharia rugosoannulata* 325.7 mg / kg, respectively (Figure 8).

In terms of Ni ion concentration, the presence of this metal was not found in most of the samples. Only one sample was detected. This is the *Stropharia rugosoannulata* 280 mg / kg species (Figure 9).

Pb concentration was calculated in the minimum and maximum range of 0.141 - 1.526 mg / kg. The lowest and highest Pb ratios were determined in *Pholiota limonella* and *Stropharia rugosoannulata* species, respectively (Figure 10).

The lowest *Cyclocybe cylindracea* 0.023 mg / kg, the highest *Agrocybe dura* 1,375 mg / kg Se ion concentration was determined (Figure 11).

Zn concentration of fungal species *Stropharia rugosoannulata* 39.47 mg / kg lowest, *Agrocybe dura* was calculated as the highest amount of 120 mg / kg (Figure 12).

As a result, with this study, the heavy metal content of fungal samples collected from Turkey's Çorum, located in the Central Black Sea, have been identified.

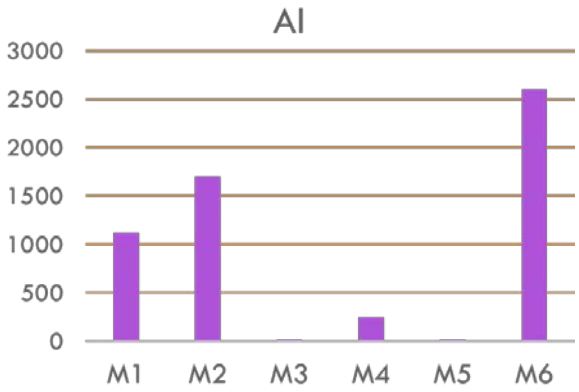

Figure 1. Al ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

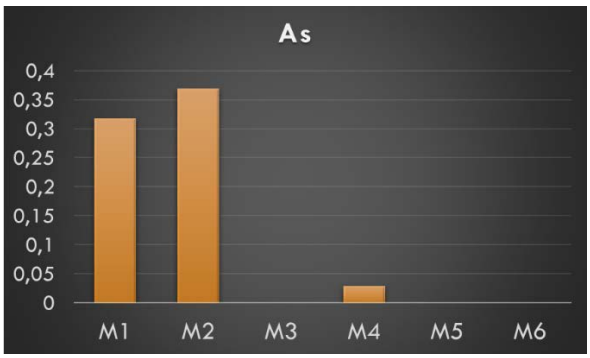

Figure 2. As ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

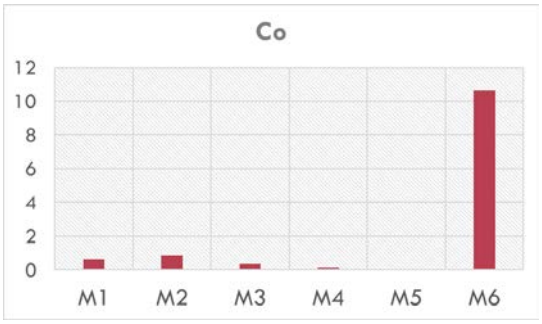

Figure 3. Co ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

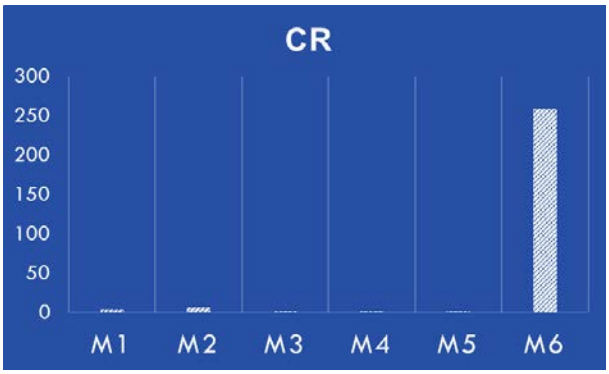

Figure 4. Cr ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

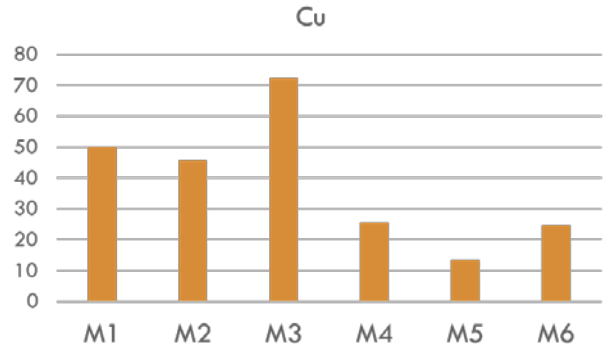

Figure 5. Cu ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

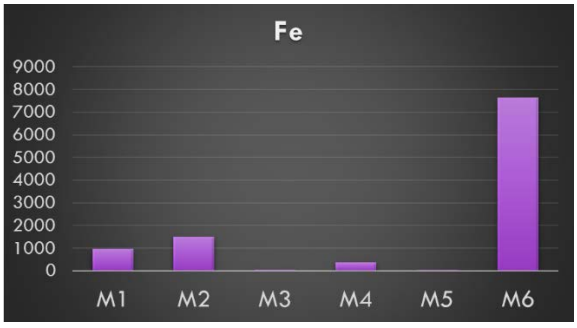

Figure 6. Fe ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

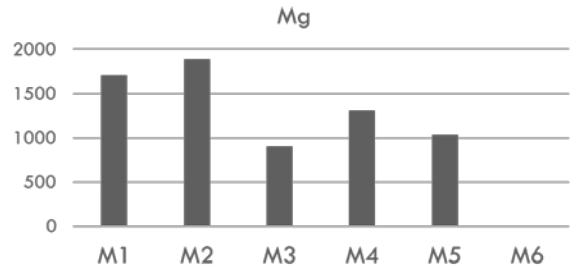

Figure 7. Mg ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. Lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

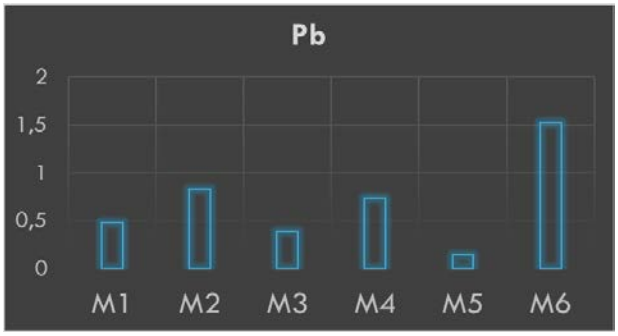

Figure 10. Pb ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

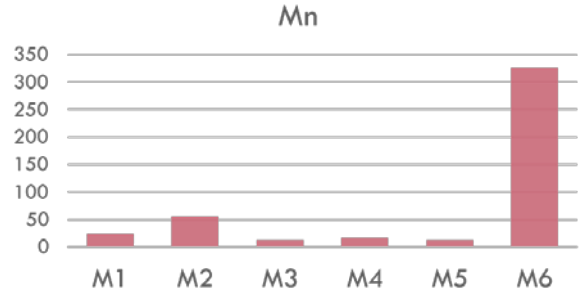

Figure 8. Mn ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. Lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

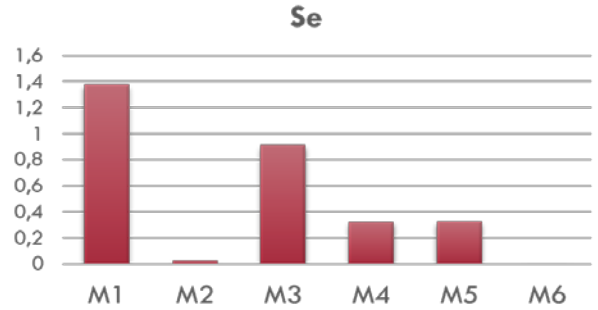

Figure 11. Se ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

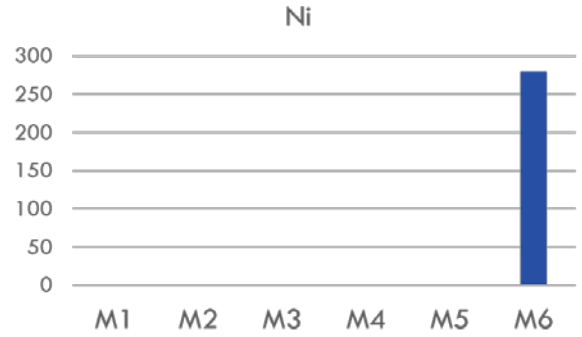

Figure 9. Ni ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

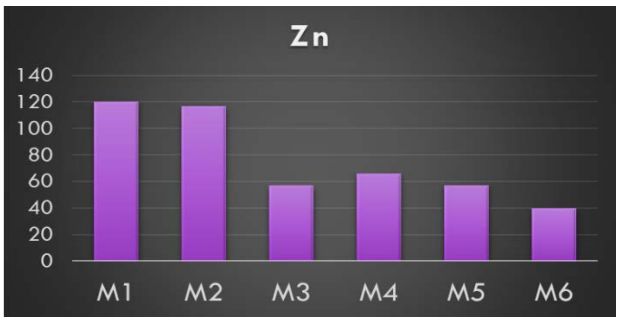

Figure 12. Zn ion concentration in fungi: *A. dura* M1, *C. cylindracea* M2, *H. fasciculare* M3, *P. lenta* M4, *P. limonella* M5, *S. rugosoannulata* M6,

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THERAPEUTIC POTENTIAL OF *TRICHAPTUM* SPP.

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ABSTRACT

Mushrooms are a group of organisms that are very important for nature and humans. Mushrooms have been important natural materials in the human diet and traditional medicine since prehistoric times, especially in Asia as well as in America, Africa, and Europe. In recent years, studies supporting the importance of mushrooms in traditional medicine have been made. Many scientific studies have been conducted, including many clinical studies providing evidence for the therapeutic properties of medicinal mushrooms. In this study, the therapeutic properties of *Trichaptum* genus were investigated. In this context, the therapeutic potential of Trichaptum genus has been emphasized by making literature searches. As a result, it was determined by the literature researches that the members of the genus *Trichaptum*, one of the wood-decaying fungi, have therapeutic potential. It is thought that members of the genus Trichaptum may be a natural source for future pharmacological studies.

Key words: Medicinal mushroom, therapeutic potential, *Trichaptum* spp., wood-decaying fungi

Introduction

The use of mushroom in traditional treatments dates back to the Neolithic era. For thousands of years, mushrooms have been considered edible and medical material in human history. Research on mushrooms have increased in recent years and many fungi have been reported to have pharmacological effects (Bal et al., 2017; Gargano et al., 2017). However, studies on mushrooms are still not sufficient. The effects of medicinal mushrooms are comparable to those of medicinal plants. Edible and medicinal mushrooms are used as a dietary product to prevent, alleviate, cure and maintain a healthy balance. Although research on mushrooms have emphasized immunological and anti-cancer properties, it is also very valuable in terms of antioxidants, antihypertensive, cholesterol-lowering, liver protection, antifibrotic, anti-inflammatory, antidiabetic, antiviral and antimicrobial properties (Akata et al., 2012; Keong, 2015; Akgül et al., 2016; Reid et al., 2016; Sevindik et al., 2017; Yıldız et al., 2017; Sevindik et al., 2018). In this study, pharmacological activities of *Trichaptum* genus, one of the important medicinal mushroom, were emphasized. *Trichaptum* genus mostly pileate polypores with upper surfaces tomentase. They usually contain a black, gray, off-white or purplish polypore. They have cylindrical basidiospore and cause white decay. The species belonging to the genus *Trichaptum* are cosmopolitan species spreading in different ecosystems in many parts of the world (Vlasák and Vlasák, 2017).

Medicinal Properties

Most mushroom are known to contain chemicals that have a significant biological effect on the body. As a result of studies on *Trichaptum* species, it has been reported that it contains protocatechuic, 4-oh-benzoic, vanillic, p-coumaric, ferulic, saponin, tannin, gallic acid, catechin, chlorogenic acid, epicatechin, syringic acid. As a result of literature researches, *Trichaptum* species have been reported biological activities such as antioxidant, enzymatic, antibacterial, laccases, lignolytic, fibrinolytic, antimicrobial, immunomodulatory, antiproliferative, cytotoxicity, DNA protective, antitubercular and antiviral activity (Table 1).

Table 1. Biological activities of *Trichaptum* species.

***Trichaptum* species**	**Biological activities**	**References**
Trichaptum sp.	Antimicrobial, antioxidant, cytotoxicity	Rollando and Hariono, 2017.
T. abietinum	Antioxidant, enzymatic, antimicrobial, immunomodulatory, anti-proliferative	Choi et al., 1999; Breuil C, 2008; Lee et al., 2013; Tetianec et al., 2014; Mbayo et al., 2015; Barad et al., 2016; Balaes et al., 2017; Gevorgyan et al., 2017; Mali et al., 2017; Smith et al., 2017; Tamrakar et al.,2017; Adhikari et al., 2019
T. biforme	Enzymatic, antioxidant, antimicrobial, cytotoxicity, DNA protective, anti-tubercular, anti-proliferative	Zjawiony J.K., 2007; Ranadive et al., 2013; Bal et al., 2017; Balaes et al., 2017; Tamrakar et al.,2017; Shnyreva et al., 2018; Payamnoor et al., 2019.
T. fuscoviolaceum	Antimicrobial, antioxidant	Nowacka et al., 2015.
T. subchartaceum	Antioxidant	Upadhyaya j., 2018.
T. sector	Antioxidant	Saparrat et al., 2000.
T. pargamenum	Cytotoxicity	Tang et al., 2017.
T. bysogenum	Enzymatic	Machado et al., 2005
T. perrottettii	Antiviral	Walder et al., 1995.

Conclusion

Mushrooms have been used by humans for different purposes in alternative medicine for many years. As a result of the researches, it was determined that the *Trichaptum* species had a potential for medical use.

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CERRENA UNICOLOR ÜZERİNDE GELİŞEN BİR FUNGİKOL MİKSOMİSET *ARCYRIA OBVELATA*

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ÖZ

Arcyria obvelata (Oeder) Onsberg, 2015 yılında S.Ü. Mantarcılık Uygulama ve Araştırma Merkezi Fungaryumu'nda bulunan mantar yetiştirme odasındaki *Pleurotus ostreatus* (Jacq.) P.Kumm. kültür kütüklerinde yetişen *Cerrena unicolor* (Bull.) Murrill. üzerinde gelişmiştir. *A. obvelata* yetişme yeri olarak ilk defa *C. unicolor* üzerinde tespit edilmiştir. Ayrıca fungikol miksomiset olarak kayıtlara geçmiştir.

Anahtar kelimeler: *Arycria obvelata*, *Cerrena unicolor*, fungikol, nem odası, Türkiye

Giriş

Myxomycetes, slime mold, aynı zamanda *Mycetozoa* veya *Myxogastria* olarak bilinen, yıllardır mantarlar aleminin özel bir grubu olarak kabul edilen, amoeboid protistlerin bir grubudur. Mikroskobik, fagotrofik, patojen olmayan, bakteri ve mantar yemeyi seven, bitki kalıntılarını ayrıştıran canlılardır. Hayat devrelerinde amoeboid, hareketli, beslenme safhalı, ya tek hücreli (miksoamip veya kamçılı oğul hücreler) veya çok hücreli (plasmodial) ve kompleks bir sporokarp tarafından spor üreten üreme safhası ile karakteristiktir. Bütün karasal iklimlerde bulunur (www.myxotropic.org).

Miksomisetlerin coğrafik dağılımı, fizyolojik gelişmeleri, genetikleri ile ilgili önemli gelişmeler kaydedilmiş olsa bile miksomisetlerin ekolojileri ile ilgili bilgiler oldukça sınırlıdır. Miksomisetler ormanın döküntü katında yaşadıkları gibi makromantarlar, böcekler, karayosunları ve likenler üzerinde de yaşayabilirler (Stephenson ve Stempen, 1994).

Miksomisetler orman biyotoplarına göre farklı gruplara ayrılmıştır. Hem likenikol hem de foliikol miksomisetler olarak tanımlanan bazı türler bir grup mantarlar üzerinde sporokarp oluşturabilirler. Bunlar fungikol mikomisetler olarak bilinirler. Sporulasyonu oluştururken basidiokarpı besin olarak kullanırlar (Yıldız ve Dülger, 2015).

Materyal ve Metot

C. unicolor üzerinde gelişen *A. obvelata* S.Ü. Mantarcılık Uygulama ve Araştırma Merkezi Fungaryumu'nda mantar üretim odalarında tespit edilmiştir. Mantar üretimi için özel olarak dizayn edilmiş bu odalarda otomasyon sistemleri ile desteklenmiş iklimlendirme, sulama ve havalandırma sistemleri mevcuttur. Kültür çalışmaları için doğal ortamlarından kesilip fungaryuma getirilen kavak ağacı kütükleri bir hafta suda bekletilerek mantar ekim için hazırlanmıştır. Ekim yapılmış kütükler %85-90 nem, 17-22ºC sıcaklık ve 12 saat gece 12 saat gündüz olacak şekilde aydınlatma, saat başı 10 dakika havalandırma ve yarım saatte bir 5 saniye su baharı ile sisleme sistemi ayarlanmıştır. Kültür mantarcılığı için uygun olan şartlar miksomisetler için uygulanan nem odası kültürü tekniğine de uygundur.

Kültür kütükleri üzerinde sadece *P. ostreatus* gelişmeyip farklı miksomiset türleri ve ağaç mantarları da gelişmiştir. Bunların arasında sadece *A. obvelata* türü *C. unicolor* üzerinde gelişmiştir.

Bulgular

Arcyria obvelata (Oeder) Onsberg

Özellikleri: Sporokarp saplı, açılmadan sonra 11 mm uzunluğa ulaşmakta, sıkışık gruplar halinde, silindir şeklinde, eğik, gevşek ve açılmadan sonra düşmekte, parlak sarı yaşlandıkça koyu sarıya dönmekte, 1-2 mm uzunluğundadır. Sap kısa, zayıf, spora benzer hücrelerle dolu, kalikulus küçük, sığ, yarı şeffaf, iç kısmı ağsıdır. Peridium tabandaki kalikulus hariç geçicidir. Kapillitium parlak sarı, oldukça esnek, kalikulustan kolayca ayrılmakta, dallanmış ve anastomoz yapmış, kapalı ağ sistemi oluşturmakta, 2.5-4 µm çapında, dikenleri, yarım halkaları ve bazı yerlerinde ağları bulunmaktadır. Sporlar yığın halde parlak koyu sarı, mikroskop ışığında soluk açık sarı, 6-8 µm çapındadır.

A. obvelata ülkemizde yapılan miksomisetlerle ilgili pek çok çalışmada farklı substratlar üzerinde tespit edilmiştir. Bu substralar *Pinus brutia* Ten. (Baba ve Tamer, 2008; Baba, 2012; Oskay ve Tüzün, 2015), *Platanus orientalis* L. (Ocak

ve Hasenekoğlu, 2009; Eroğlu ve ark., 2015), *Salix* sp. çürümüş kütük, *Populus* sp. kesik kütük kabuk (Eroğlu ve Kaşık, 2013), *Abies nordmanniana* subsp. *bornmulleriana* Mattf. (Ergül ve Akgül, 2011), *Quercus* sp. odunlar, *Pinus pinea* L. (Baba ve Tamer, 2008), *Carpinus betulus* L. (Oran ve ark., 2006), *Pinus nigra* J.F.Arnold (Demirel ve ark., 2006), *Olea* döküntü dal (Dülger ve ark., 2006) şeklinde bildirilmiştir.

Tartıma Sonuç

Ülkemizde ilk fungikol miksomiset Gölyaka (Düzce) ilçesinde yapılan çalışmada *Arcyria incarnata* (Pers. ex J.F.Gmel) Pers., *Fomes fomentarius* (L.) Fr. üzerinde tespit edilmiştir (Yıldız ve Dülger, 2015). Bunun haricinde en iyi bilinen fungikol miksomiset *Badhamia utricularis* (Bull.) Berk. olup *Stereum hirsutum* (Willd) Pers.ve *Phlebia radiata* Fr. üzerinde sıkça bulunmuştur. Bunun haricinde askomisetlerin üzerinde gelişen miksomisetlerde bulunmaktadır (Ing, 1994).

Çalışmamızın diğer çalışmalara göre bir diğer farklılığı ise kültür kütüklerinin üzerinde gelişmiş olmasıdır. Belçika Mantar Araştırma Merkezindeki mantar yetiştirme odalarındaki *Pleurotus* kültür kütükleri üzerinde ve *Pleurotus* basidikarpları üzerinde *Physarum compressum* Alb. & Schwein. ve *Stemonitis herbatica* Rostaf. örnekleri geliştiği bildirilmiştir (Desrumaux ve ark., 2003). Literatüre göre, miksomisetler kültür kütükleri üzerinde gelişen mantarlar üzerinde zayıf hastalık olarak bildirilmiştir (Chung ve ark., 1998; Lee ve ark., 2014). Ancak yapılan çalışmalara göre miksomisetler patojen olmayıp, mantar hif ve sporlarını besin olarak tüketmektedirler.

Sonuç olarak, Yıldız ve Dülger (2015)'in yaptıkları çalışmaların sonucuna uygunluk göstererek *A obvelata* gibi kozmopolit olan miksomisetlerin gelişim için substrat yönüyle seçici olmadığı düşünülmektedir.

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www.myxotropic.org

MEDICAL PROPERTIES OF EDIBLE MUSHROOM LACTARIUS DELICIOSUS

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ABSTRACT

Mushrooms have been in our tables for many years in terms of flavor. Recently it has been an important source of dietary products and biologically medicinal compounds. It has many biological activities thanks to the secondary metabolites they produce in mushrooms. In this study, biological activities of *Lactarius deliciosus* (Fries) S.F. mushroom was investigated. *L. deliciosus* is one of the popular mushrooms consumed as food due to its unique sensory properties. It is an important natural source not only because of its basic nutritional properties but also in terms of polyphenols. In previous studies, *L. deliciosus* mushroom has been reported to have cytotoxic activity, antioxidant, antimicrobial, antihyperglycemic, anti-tumor, immunostimulant activity, anticancer, anti-inflammatory, hypocholersterolemic and anticholinesterase activities. In this context, *L. deliciosus* mushroom was found to be an important medicinal mushroom as well as being an edible mushroom.

Key words: Biological activity, Edible mushroom, *Lactarius deliciosus*, medicinal mushroom

Introduction

Medicinally mushrooms have long been used as an alternative medicine to promote longevity in terms of human health (Akgül et al., 2017). With the discovery and development of active compounds in drugs, interest in secondary metabolites of fungi has increased (Sevindik et al., 2016). In recent years, secondary metabolites obtained from fungi have been isolated and provided pioneering compounds for novel drug discovery that may contain immunomodulatory and anticancer biological activity chemo preventive agents (Zhong and Xiao, 2009; Bal et al., 2017; Sevindik et al., 2018). Mushroom of the genus *Lactarius* (Russulaceae, Basidiomycota) form a milky juice when the fruit organs are injured. In the vast majority of *Lactarius* species, different types of sesquiterpenes play an important biological role, responsible for the sharpness and bitterness of milky water and for the formation of a chemical defence system against predators. *L. deliciosus* fungus, known as Çıntar mushroom, is widespread in Turkey. *L. deliciosus* is an ectomicorrhizal fungus that grows in coniferous woodlands, especially under pines. *L. deliciosus* mushrooms are high in nutritional value and biological activity (Liu, 2007). In this study, biological activities of *L. deliciosus* mushroom, which are collected intensively from nature and consumed extensively, are reviewed.

Biological Activity

As a result of literature research, *L. deliciosus* mushroom has been reported to have antimicrobial, antioxidant, cytotoxicity, enzymatic, anticholinesterase, anticancer, antitumor, antihyperglycemic, hydratase, esterase and immunostimulant activities (Table 1).

Table 1. Biological Activities of *L. deliciosus*

Biological Activities	References
Antimicrobial activity	Dulger et al., 2002; Santoyo et al., 2009; Altuner and Akata, 2010; Ozen et al., 2011; Alves et al., 2012; Onbaşılı et al., 2015; Dündar et al., 2016; Kosanić et al., 2016; Sadi et al., 2016; Tala et al., 2017
Antioxidant activity	Ferreira et al., 2007; Erdogan et al., 2011; Ozen et al., 2011; Akata et al., 2012; Sagar and Thakur, 2012; Fernandes et al., 2013; Pogoń et al., 2013; Öztürk et al., 2014; Xiao-ling et al., 2014; Onbaşılı et al., 2015; Dimitrijević et al., 2016; Dündar et al., 2016; Kosanić et al.,2016; Sadi et al., 2016; Adanacioglu et al., 2017; Bakır et al., 2017; Erdoğan et al., 2017; Bozdoğan et al., 2018; Çol Ayvaz et al., 2019; Xu et al., 2019
Cytotoxicity	Dündar et al., 2016; Hou et al., 2019
Enzymatic activity	Santoyo et al., 2009; Çol Ayvaz et al., 2019
Anticholinesterase activity	Öztürk et al., 2014; Çol Ayvaz et al., 2019
Anticancer activity	Kosanić et al.,2016; Sadi et al., 2016
Antitumor activity	Ding et al., 2015
Antihyperglycemic Activities	Xu et al., 2019
Hydratase activity	Karaçam et al.,2015
Esterase activity	Karaçam et al., 2015
Immunostimulant Activity	Hou et al., 2013

Conclusion

In this study, the biological activities of *L. deliciosus*, one of the edible mushroom, were investigated. As a result of literature studies, it was determined that *L. deliciosus* can be evaluated in pharmacological studies in addition to edible properties.

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MAKROMANTARLAR VE BAKTERİLER ARASINDAKİ ETKİLEŞİMLER

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ÖZ

Spor üreten, fruktifikasyon yapısı oluşturan mantarlar bakterileri de içeren birçok organizma için mükemmel doğal besin kaynağıdır. Makromantarların fruktifikasyon yapıları genellikle toprak üstünde olmasına rağmen bazıları toprak altındadır. Bakteriler ve mantarların pozitif ve negatif ilişkiler kurduğu gösterilmiştir. Patojen ve saprofit olan bakteriler besin kaynağı olarak mantarın fruktifikasyon yapısını kullanırlar. *Pseudomonas tolaasii* salgıladığı toksinle fruktifikasyon yapısını bozarak kahverengi leke hastalığına neden olur. *Ewingella, Pseudomonas ve Stenotrophomonas* genuslarına ait patojenik bakterilerin yüksek kitinaz aktivitesi ile mantarın fruktifikasyon yapısının bozduğu bilinmektedir. Buna karşılık, *Pseudomonas putida* üyelerinin *Agaricus bisporus'*ta basidium gelişimini uyarabildiği belirtilmektedir. Benzer şekilde, *P. putida* suşlarının mantarın misel büyümesini teşvik etme kabiliyeti, in vitro olarak gösterilmiştir. Makromantar ile birlikte yaşayan bu bakteriler ayrıca misel büyümesini, spor çimlenmesini, mikoriza oluşumunu destekleyebilir ve diğer patojen organizmalara karşı antagonistik etki göstererek fayda sağlayabilmektedir. Bu gibi ilişkilerde bakteri mantar hücrelerinde endosimbiyotik olarak yaşar. Yapılan birçok çalışmada mantar hastalıklarına karşı mücadelede bakteri kullanılmıştır. Bu çalışmalarda kültür mantarlarında bakteri kaynaklı hastalıkları tedavi etmek için yabani mantarlardan izole edilen bakteriler kullanılmıştır ve hastalık bulgularında % 96 oranında azalma gözlenmiştir. Bu alandaki araştırmalar, tıbbi ve biyoteknolojik değeri olan yeni metabolitlerin tespiti için de önem arz etmektedir.

Anahtar kelimeler: Kültür mantarı, Bakteri, Etkileşim

Interactions Between Cultivated Mushroom and Bacteria

ABSTRACT

Mushroom form a spore-producing fructification structure, an excellent natural source of nutrients for a widerange of organisms, includingbacteria. Fructificationstructures, although some are briefly underground, mostly occurs on soil. It was shown that bacteria have both positive and negative relationships with fungal fructification structures. Bacteria as pathogens and saprophytes use the fructification structures of mushroom as a foodsource. Forexample, *Pseudomonas tolaasii* degrades the structure of fructification with toxins secreted, causing brown spot disease. It is known that fructification structures of mushroom are disrupted by high chitinase activity of pathogenicbacteriasuch as *Ewingella, Pseudomonas ve Stenotrophomonas.* Incontrast, *Pseudomonas putida* members have been shownto be capable of stimulating the development of basidium in Agaricusbisporus. Similarly, the ability of *P. putida* strains to promote hyphal elongation of the fungus was found in vitro. Bacteria can also promote micelle growth, spore germination, mycorrhiza formation and provide indirect benefit by controlling pathogens. In such associations, bacteria live as endosymbiotics in fungal cells.In a study conducted by researchers, bacteria were used in the fight against mushroom diseases. In this study, bacteria isolated from wild type mushrooms were used to treat diseases caused by bacteria in cultured mushroom and 96% decrease in disease findings was observed. Research in this area is also important for the detection of new metabolites with medical and biotechnological value.

Key words: Cultivate Mushroom,Bacteria, Interaction

Giriş

Bitkiler ve hayvanlar gibi yüksek yapılı organizmaların ökaryotik dokularında ve hücrelerinde yaşayan bakterilerle ilgili birçok araştırma yapılmış ve halen yapılmaktadır. Ökaryot hücre yapısına sahip makromantarlarla etkileşim halinde olan bakterilerle ilgili araştırmalar ise çok sınırlıdır. Özellikle makro mantarlarda hastalık etkeni olan patojen bakteriler ve bu bakterilerin virulans faktörleri ile ilgili çok sayıda çalışma yapılmıştır (Kobayashi ve Crouch, 2009). Son yapılan araştırmalar makro mantarların bakterilerle işbirliği yaptığı ve bu iki organizma grubu arasındaki yararlı etkileşimlerin zararlı etkileşimden daha yaygın olduğunu göstermiştir. Bu alanda yapılan az sayıda araştırma, makro mantarlarla birlikte yaşayan bakterilerin makro mantarların fruktifikasyon yapısında ve miselleri üzerinde ektosimbiyont olarak veya içerisinde endosimbiyont olarak bulunduğunu ortaya koymuştur (Olsson ve ark.2017). Endosimbiyontların, makro mantarların fruktifikasyon yapısının oluşumunu, misel gelişimini ve sporulasyonu teşvik ettiği belirlenmiştir (Carrasco ve Preston2019). Bu çalışmalar şapkalı mantarlarda, özellikle endosimbiyont bakterilerin varlığının ortaya konmasının çok zor bir süreç olduğunu da göstermiştir (Kobayashi ve Crouch,2009). Çünkü fungusların hasarlı hiflerine, etrafta bulunan bakteriler yerleşip çoğalabilir. Bu şekilde yerleşen bakteriler endosimbitont bakterinin izolasyonunu zorlaştırmakta ve endosimbiyont olarak yanlış değerlendirilmelerine neden olmaktadır. Endosimbiyont olarak bulunan bakterilerle ilgili çalışmalar arttıkça bu bakterilerin özellikle kültür mantarı üretiminde karşılaşılan ve verim kaybına neden olan birçok hastalığın tedavisinde biyolojik kontrol ajanı olarak kullanılabileceği belirtilmiştir (Carrasco ve Preston, 2019). Ayrıca doğada bulunan besin değeri yüksek ve kültürü yapılamayan bazı mantarların üretiminde endobakterilerin kullanılabileceği düşünülmektedir. Bu derlemede makro mantar bakteri etkileşim tipleri ve bu etkileşimin biyoteknolojik önemi ile ilgili yapılan çalışmalar değerlendirilecektir.

Makromantar ve Bakteri Etkileşim Tipleri

Bakterilerin ökaryotik canlılarla simbiyotik ilişkilerinin belirlenmesi önemli temel konulardan biridir. Simbiyozis terimi etkileşim içerisindeki ortakların herhangi biri için olumlu ya da olumsuz sonuçları olup olmadığına bakılmaksızın "farklı organizmaların birlikte yaşaması" anlamında kullanılmaktadır. Simbiyotik yaşam mutualism, komensalizm, antagonizm, amensalizm, parazitizm ve avlanma şeklinde olabilir. Simbiyotik ortaklar arasında kesinlikle tarafsız ilişkilerin bulunma ihtimali de vardır (Olsson ve ark.2017). Yüksek yapılı bitki ve hayvanların bazı organ ve dokularında simbiyotik olarak yaşayan bakteriler iyi bilinmesine karşın, şapkalı mantarlarla simbiyotik ilişki yaşayan bakteriler hakkında sınırlı sayıda bilgi mevcuttur.

Bakteri mantar etkileşimi hakkında edinilen bilgilere göre bakteri mantar hifi içinde endobiyont/endosimbiyont olarak ve hifin yüzeyinde ya da hifin yakın çevresinde bir matriks tarafından tutulan birkaç bakteri tarafından oluşturulmuş biyofilmlerle ilişkili ektobiyontlar / epibiontlar / ektosimbiyontlar / episimbiyontlar olarak da bulunabilir. Bakteriyel endosimbiyontlardan bazıları sadece mantarın hücre içi ortamlarında bulunabilirler ve hücre dışı ortamda yaşayamaz (zorunlu endobakteri. Bazıları da hem mantar hücrelerinde hem de hücre dışı ortamlarda (fakültatif endobakteri) yaşayabilirler (Olsson ve ark.2017).

Makromantarların toprak üstü ve toprak altı bölgelerinde simbiyotik ilişki içinde farklı bakteri türlerinin bulunduğu yapılan çalışmalarla gösterilmiştir. Bu bölgelerden izole edilen bakterilerin şapkalı mantarın yaşamı üzerinde olumlu ve olumsuz etkileri olduğu saptanmıştır. Mantar bakteri etkileşimlerinin oluşumu ve sonuçları bu canlı grupları arasında kimyasal iletişimle gerçekleştirildiği bilinmektedir. Gelişen transkriptomik, proteomik ve metabolomik çalışmalar bu canlı grupları arasında etkileşimin aydınlatılmasına olanak sağlayacağı belirtilmiştir (Olsson ve ark., 2017).

Bakteri ve Makromantarlar Arasındaki Olumsuz Etkileşimler

Yüksek protein, mineral ve vitamin içeriğiyle yenebilir mantarların fruktifikasyon yapısı bakterileri de içeren birçok canlı için en iyi doğal besin kaynaklarından biridir. Bu nedenle özellikle kültür mantarları birçok bakteri tarafından enfekte olur bunun sonucunda da ürün kaybı olmaktadır (Olsson ve ark., 2017, Carrasco ve Preston, 2019)

Kültür Mantarlarında Hastalıklara Neden Olan Bakteriler

Kültürü yapılan şapkalı mantarlarda hastalık etkeni olarak saptanan patojen bakteriler çok uzun süreden beri çalışılmaktadır. Bakterilerin neden olduğu mantar hastalıklarının bazıları semptom benzerliğine göre gruplandırılabilirken bazıları birbirlerinden oldukça farklıdır. Örneğin çeşitli bakteri grupları şapkalı mantarlarda leke hastalığı oluşturabilir. Bu nedenle farklı hastalık etkeni olan ajanlar benzer semptonlara neden olduğundan dolayı karışıklığa sebep olmaktadır. Leke hastalığı semptomları hem değişen çevresel koşullara göre hem de tür ve suşlara bağlı olarak değişebileceğinden, hastalığın etkenini doğru olarak saptamak bu nedenle çok önemlidir. *Pseudomonas tolaasii*' nin neden olduğu kahverengi leke, bugüne

kadar en fazla çalışma yapılan hastalıktır (Kobayashi ve Crouch, 2009). Agaricus' da hafif benek benzeri semptomlara neden olan *Pseudomonas agarici* aynı zamanda istiridye mantarında sarı leke hastalığının etken ajanı olarak tanımlanmıştır. *Pseudomonas agarici türünün virülans faktörleri tam olarak belirlenememiştir (*Cantore ve Lacobellis, 2004). Çeşitli bakteri türlerinin neden olduğu şapkalı mantar hastalıklarının bir başka sınıfı yumuşak çatlaklardır (soft root). Bu hastalıkla ilgili iki bakteri türü *Pseudomonas gladioli* pv. a*gricicola ve Janthinobacterium agaricidamnosum* olarak tanımlanmıştır (Lincoln ve ark., 1991,1999). Ardından farklı tip yumuşak çatlağa neden olan üçüncü bir bakteri *Pantoea* sp. olarak tanımlanmıştır (Kim ve ark.2007). İnternal sap nekrozu olarak bilinen mantar hastalığı etkeni *Ewingella americana*' dır. Şapkalı mantar hastalıklarının çoğunda olduğu gibi, patojenite mekanizmaları tam olarak belirlenememiştir (Inglis ve Peberdy,1996). Kültüre edilen şapkalı mantar hastalıklarından, mumya (mummy) hastalığı *P. aeruginosa* ve *P. fluorescens* türleri ile ilişkilendirilse de tam olarak etkeni saptanamamıştır (Kobayashi ve Crouch, 2009).

Mantarlar ve Bakteriler Arasında Yararlı Etkileşimler

Makromantarların fruktifikasyon yapılarının ve misellerinin dış ve iç kısımlarda simbiyotik ilişkili bakteriler bazı araştırmalarla izole ve identifiye edilmiştir (Carrasco ve Preston 2019). Roux ve arkadaşlarının (2016) yaptığı bir çalışmada siyah yer mantarı olarak bilinen *Tuber melanosporum veTuber brumale'* nin misel yapısı laboratuvar koşullarında üretilerek misel kenarından izole edilen bakterinin moleküler tanılaması sonucu, *Rhodopseudomonas* genusuna ait olduğu ve bakterinin obligat simbiyont olduğu gösterilmiştir. Lee ve arkadaşlarının (2015) yaptığı bir araştırmada kral istiridye mantarının (*Pleurotus eryngii*) yenebilen kısımlarının endobakteriyel çeşitliliği moleküler olarak incelenmiştir. Endosimbiyont bakterilerin çoğunun Firmicutes ve Actinobacteria' ya ait olduğu gösterilmiştir. İzolatların mantar için olumlu mu ya da olumsuz etkileri daha sonra yapılacak çalışmalarla ortaya çıkarılacaktır.

Xiang ve arkadaşlarının (2017) yaptığı bir çalışmada *Agaricus bisporus'*un fruktifikasyon yapısından 55 bakteriyel suş izole ve identifiye edilmiştr. İzole edilen bakteriler gram-pozitif *Bacillus, Lysinibacillus, Paenibacillus, Pandorea* ve *Streptomyces* genusları ve gram negatif *Alcaligenes* ve *Pseudomonas* genuslarına ait türler olarak tanımlanmışlardır. Indol asetik asit (IAA) ve selülaz üretimi ile fosfatı çözündürme yetenekleri bitki büyümesini teşvik eden rhizobakterilerin özelliği olduğu için izolatların bu özellikleri incelenmiştir. Bazı izolatların yüksek miktarda IAA ve selülaz ürettiği ve fosfat çözündürme yeteneği olduğu ortaya çıkarılmıştır. İzolatların seçilen 6 test organizmasına karşı antimikrobiyal aktiviteleri de incelenmiştir 40 izolatın test edilen *E.coli* ve *S. aureus*'a karşı, 27 izolatın *C.lunata* ve *F.oxyporum f. sp. vasinfectum*'a karşı antimikrobiyal aktivitesi olduğu saptanmıştır *Rhizoctonia solani* ve *Alternaria solani*'ye karşı da 15 izolatın antimikrobiyal etkiye sahip olduğu saptanmıştır.

İzole edilen bazı bakteri türlerinin makromantarlarda büyümeyi, misel gelişimini teşvik ettiği, aroma oluşumunda etkili olduğu, pigmentasyonu sağladığı, atmosferik azotun fiksasyonunu sağlayarak azot ihtiyacını karşıladığı ve hastalık yapıcı mikroorganizmalara karşı koruyucu özellikleri olduğu ortaya konmuştur (Carrasco ve Preston, 2019).

Mantarlarda büyümeyi teşvik edici bakterilerle (MGPB-mushroom growth promoting bacteria) ilgili yapılan az sayıda çalışma olmasına karşılık bitki büyümesini teşvik eden özellikle rhizobakteriler ile (PGPR-Plant growth promoting rhizobacteria) ilgili bir çok çalışma bulunmaktadır (Carrasco ve Preston, 2019). Birçok *A.bisporus* suşu büyümeleri sırasında vejetatif büyümeden seksüel aşamaya geçebilmek için örtü toprağına ihtiyaç duymaktadır (Eren ve Boztok, 2013, Kertesz ve Thai., 2018, Carrasco ve Preston, 2019). Kullanılan örtü toprağının fiziksel, kimyasal, mikrobiyolojik özellikleri ve çevresel faktörlerin (sıcaklığın ve CO_2 miktarının azaltılmasıyla) düzenlenmesiyle primordia gelişimi ve fruktifikasyon yapısının oluşumu teşvik edilmektedir (Zarenejad ve ark., 2011). Bu etkinin temelinde örtü toprağında bulunan saprofitik bakterilerden bazılarının varlığının (*P. putida* gibi) Agaricus' da gelişimi teşvik ettiği birçok çalışmayla gösterilmesine rağmen (Rainey,1991, Zarenejad ve ark, 2011,Colauto ve ark., 2016, Kertesz ve Thai., 2018, Aslani ve ark.2018) bu alanda daha fazla çalışma yapılmasına ihtiyaç vardır. *Pleurotus ostreatus'* un (istiridye mantarı) miselial yüzeyinden izole edilen bakterilerden *fluoresan özellik gösteren Pseudomonas* türlerinin mantarın büyümesini teşvik ettiği gösterilmiştir (Cho ve ark., 2003).

Agaricus blazei türünün hasat zamanı diğer Agaricus türleri ile karşılaştırıldığında daha geçtir. İçeriğinde bulunan polisakkarit-protein kompleksi (PSPC-polysaccharide-protein complex) gibi biyoaktif bileşikler sayesinde antioksidan, antimutagenik ve antikanser fonksiyonu olmasından dolayı üretimleri önemlidir. Mantarla ilişkili bakteriler kullanılarak hasat zamanının kısaltılması ve enerji tasarrufu sağlanması ile ilgili çalışmalar da yapılmıştır. Bu çalışmalarda bakteri inokule edilmiş mantarlarda olgunlaşma süresinin oldukça kısaldığı, ürün veriminin arttığı ve polisakkarit-protein kompleksi miktarının arttığı saptanmıştır (Young ve ark., 2013).

Çam mantarı (Pıne mushroom PM), *Tricholoma matsutake* ile yapılan bir çalışmada fruktifikasyon yapısından izole edilen endobakterilerden bazılarının misel gelişimini teşvik ettiği ve mantarda hastalığa sebep olan küfleri baskılayarak indirekt pozitif etkisi olduğu ortaya konmuştur (Oh ve ark, 2018).

Vahdatzadeh ve arkadaşlarının (2015) yaptığı bir metagenom çalışmasında bitki kökleriyle simbiyotik ilişki kurarak ektomikoriza oluşturan Ascomycetes sınıfında yer alan yer mantarlarının (Truffles) (*Tuber* spp.) aromasının oluşumunda mikrobiyomun rolü ele alınmıştır. Truff mikrobiyomunda baskın grubun bakteriler olduğu *T. borchii, T.magnatum, T. aestivum, ve T. Melanosporum* türlerinin aromasında bakterilerin önemli katkısı olduğu sonucuna ulaşılmıştır.

Truff mantarı ile ilgili yapılan çalışmalarda mantardan izole edilen bazı bakterilerin atmosferik azotu fikse edebildiği ve mantarların azot ihtiyacını bu bakteriler sayesinde karşıladığı ortaya konmuştur (Barbieri ve arkadaşları 2010). Tauber ve arkadaşlarının yaptığı bir çalışmada Basidiomycetes sınıfında yer alan *Serpula lacrymans'* da pigment salgılanmasının çeşitli bakteriler tarafından uyarıldığı ortaya çıkarılmıştır (Tauber ve ark., 2016).

Bakteriyel patojenler tarafından salgılanan, mantar hücre zarını tahrip eden bileşikleri, mantarla simbiyotik olarak yaşayan bazı bakterilerin detoksifiye edebildiği bazı çalışmalarla gösterilmiştir. Bununla ilgili olarak doğada bulunan Agaricales'le yapılan bir çalışmada birkaç tolaasin detoksifiye edici bakteri suşu izole edilmiştir. Tolaasin mantarlarda *P. tolaasii'* nin etken olduğu kahverengi leke hastalığı semptomlarına neden olan faktörlerden biridir(Tsukamoto ve ark. 2002).

A.bisporus türü ile ilgili yapılan çalışmalarda yeşil küf hastalığına karşı biyolojik mücadelede mantarın kompostundan izole edilen *B. subtilis ve B. velezensis* suşları kullanılmış ve kullanımda olan kimyasal fungisid ile aynı etkinliğe sahip olduğu belirtilmiştir **(**Svetlana ve ark.2017**,** Caroline ve ark.2018**).**

Makromantar ve Bakteri Etkileşim Tiplerinin Biyoteknolojik Önemi

Bakterilerin kültür mantarı üretimi aşamalarında ham maddelerin işlenmesinde, fungal ve bakteriyel patojenlerin inhibisyonunda ve fruktifikasyon oluşumunun teşvik edilmesinde önemli etkileri olduğu bilinmektedir (Kertesz ve Thai, 2018). Ektomikorizal birlikteliği teşvik etmeleri, enzim aktiviteleri ile substratları parçalayarak mantarın daha iyi beslenmesini sağlamaları, mantarın fruktifikasyon yapısını oluşturmasını engelleyen mantarın ürettiği uçucu organik bileşikleri tüketmeleri, ürün parazitlerine karşı koruyan ya da rakabetçi fungusları baskılayan bileşikleri salgılamaları mantar ve bakteri birlikteliğinin faydalarından bazılarıdır. Uçucu organik bileşiklerin (VOC' volatıve organıc complex- 1-octen-3-ol) bazı bakteriler tarafından tüketilmesi hem mantarın bozulmasını engeller hem de fruktifikasyon yapısının gelişimini uyarır. *Pseudomona sputida* türünün uçucu organik bileşikleri tüketerek gelişmeyi, büyüme ve primordia oluşumunu uyardığı belirtilmiştir (Zarenejad ve ark., 2012). Makromantar bakteri etkileşimlerinin daha iyi anlaşılması kültür mantarı üretiminde yeni tekniklerin kullanılmasına olanak sağlayarak kar payını arttıracağı ve çevreci bir anlayış getireceği açıktır. Yararlı bakterilerle aşılanmış mantarların kullanımı ve mantar kültür ortamına ilave edilmesi gibi uygulamalar geliştirilebilir. Bu gibi tekniklerin kullanımıyla, hasat zamanı 60 gün olan bir kültür mantarının 26 güne kadar azaldığı ve taze mantar veriminde % 215' e kadar bir artış olduğu bildirilmiştir (Young ve ark., 2013).

Mantar hastalıklarının tedavisinde kimyasal maddeler kullanılmaktadır. Bu maddeler hem çevreye zarar vermekte hem de maliyeti arttırmaktadır. Günümüzde organik ürünlerin tercih edilmesi ve kullanılan kimyasallara dirençli suşların ortaya çıkması nedeniyle mantar hastalıklarına karşı bazı bakterilerin kullanılabileceği düşünülmüştür. Özelikle en çok kültürü yapılan *A. bisporus*' un bazı hastalıklarına karşı bakteriyel suşların kullanıldığı çalışmalar yapılmış ve oldukça etkili olduğu da saptanmıştır (Milijašević-Marčić ve ark., 2017, Pandin ve ark, 2018). Elde edilen bu sonuçların mantar üretiminde kullanılabilmesi için daha fazla araştırma yapılması gerekmektedir.

Makromantarların sekonder metabolitlerinden bazıları antimikrobiyal özelliklere sahiptir ve ilaç olarak kullanımları açısından taranmaktadır. Makromantar içinde yaşayan bakteriler, şu ana kadar bu açıdan çalışılmamıştır. Makromantarların geliştiği ortamlar yüksek asit seviyesi, reaktif oksijen türlerinin bulunması ve toksik sekonder metabolitler nedeniyle ekstrem hale gelir. Bu ekstrem ortamda bulunan bakteriler bu koşullara dayanabilen özel türlerdir. İzole ve identifiye edilen türlerle ilgili yapılacak çalışmalar ve genom analizleri sayesinde saptanacak yeni metabolitler tıbbi tedavilerde ve biyoteknolojik olarak önemli maddelerin eldesi ve korunmasında kullanılabilir(Boer ve Wal,2008)

Sonuç

Makromantar bakteri birlikteliğinin tahmin edilenden daha yaygın ve önemli olduğu yapılan az sayıda araştırma ile ortaya konmuştur. Birlikte yaşayan ortakların mikroskobik olması, birlikteliğin karmaşıklığı ve etkileşim sırasında gerçekleşen olayların doğru sıralanmasının gerekliliği bu alanda çalışanları zorlayıcı kısımlardan bazılarıdır. Simbiyotik ilişkinin ortaya konması ve karakterizasyonu yeni yöntemlerin bulunması ve yaygınlaşmasıyla daha kolay ve kısa sürede

yapılabilecektir. Yeni kültüvasyon ortamları ve yöntemleri ile yeni moleküler tekniklerin geliştirilmesi bu nedenle önemlidir. Ayrıca omik yaklaşımlar, moleküler yöntemler ve evrimsel ilişkilerin kullanılması mantar-bakteri etkileşimlerinin altında yatan mekanizmaları anlamamızı sağlayacaktır. Gelecekte yapılacak çalışmalarla tıp, tarım, ormancılık ve biyolojik ıslah alanlarında kullanılabilecek yeni metabolitlerin keşfine olanak sağlayacaktır.

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POSTER PRESENTATIONS FULL TEXT

EKMEKLİK VERİM DENEMESİ SET-1 MATERYALİNİN SÜRME HASTALIĞINA (*Tilletia* spp.) REAKSİYONLARININ BELİRLENMESİ

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ÖZ

Buğday, en eski ve en önemli tahıllardan biridir. Sürme (*Tilletia* spp) hastalığı fungal bir stres faktörü olup buğday verim ve kalitesini olumsuz yönde etkilemektedir. Tohumculuk endüstrisi için önemli olan sürme hastalığın kontrolünde en çok tercih edilen kontrol metodu kimyasal savaşımdır. Fakat kimyasal ilaçların kullanılmasının bazı dezavantajları vardır. Bu hastalığın kontrolünde genetik dayanıklılık en ucuz, çevreci ve çiftçi için en pratik kontrol metodudur. Bu çalışma, Ankara Tarla Bitkileri Merkez Araştırma Enstitüsü Müdürlüğü (TARM) Buğday Islah Birimi tarafından geliştirilen Ekmeklik Verim Denemesi Set -1 materyallerinin İkizce (Ankara) ekolojik koşullarında yapay epidemi altında sürme hastalığına (*Tilletia* spp.) karşı reaksiyonlarının belirlenmesi amacıyla yürütülmüştür. Bu amaçla 19 adet hat ve 6 adet standart çeşit (Bayraktar 2000, Demir 2000, Tosunbey, Bezostaja-1, Kenanbey) test edilmiştir. Araştırma 2014-2015 üretim sezonunda TARM Ankara İkizce lokasyonunda bulunan Uygulama ve Araştırma Çiftliğinde 2 tekerrürlü olarak yürütülmüştür. Materyal 33 cm sıra arası mesafe ve 1 metrelik sıralara elle ekilmiştir. Değerlendirme her sıradaki sağlam ve hastalıklı başaklar sayılarak yapılmıştır. Araştırma sonuçlarına göre, 3 (%16) hat dayanıklı, 16 (%84) hat ve tüm standart çeşitler hassas olarak belirlenmiştir. Sonuçlar sürme hastalığına karşı dayanıklı materyallerin bulunduğunu ve bunların çeşit geliştirme çalışmalarında kullanılmak için bölge verim kademesine aktarılabileceğini ve dayanıklılık ıslahı çalışmalarında genitör kaynak olarak değerlendirilebileceğini göstermektedir.

Anahtar kelimeler: Ekmeklik buğday ıslahı, sürme hastalığı (*Tilletia* spp.), reaksiyon testi, dayanıklılık ıslahı

Determination of Reaction of Yield Trial Bread Wheat Set-1 Materials to Common Bunt (*Tilletia* Spp.)

ABSTRACT

Wheat is one of the oldest and most important of the cereal crops. Bunt (*Tilletia* spp) disease is a fungal stress factor and adversely affects wheat yield and quality. In the control of the common bunt disease, which is important for the seed industry; chemical control is the most preferred of control method. However, the use of chemical fungicide has some disadvantages. Genetic resistance in the control of this disease is the cheapest, environmentalist and the most practical control method for the farmer. This study was carried out in order to determine the reaction of Yield Trial Bread Wheat Set-1 materials developed by Ankara Field Crops Central Research Institute (TARM) Wheat Breeding Unit to artificial epidemic ecological conditions common (*Tilletia* spp.) in İkizce (Ankara). For this purpose, 19 lines and 6 standard cultivars (Bayraktar 2000, Demir 2000, Tosunbey, Bezostaja-1, Kenanbey) were tested. The material was planted 33 cm row spacing and 1 meter rows by manually. The research was conducted in 2014-2015 growing season with 2 replications in TARM Ankara İkizce Location Application and Research Farm. Evaluation was made by counting healthy and diseased spike in each row. According to the results, 3 (16%) lines were resistant (0-25%) and 16 (84%) lines were susceptible (26-100%). All standard cultivars have been determined susceptible. The results show that there are genotypes resistant to common bunt and these can be carried to the advance yield trial stage for use in cultivar studies and can be considered as a genitor source in resistance breeding studies.

Key words: Bread wheat breeding, common bunt (*Tilletia* spp), resistance breeding, reaction test

Giriş

Sürme (*Tilletia* spp) hastalığı fungal bir stres faktörü olup buğday verim ve kalitesini olumsuz yönde etkilemektedir. Hastalık üretici tarafından "Kör, Karamuk ve Karadoğu" olarak bilinmekte olup hasat-harman sırasında hastalıkla bulaşık olmayan buğday tanesinin sakal kısmına tutunmaktadır. Hastalık önemli verim kayıplarının yanı sıra içerdiği "trimetil amin" maddesi nedeniyle bulaşık üründe balık yağı kokusuna benzer koku yayması ve bu üründen elde edilen un/unlu mamuller de bu kokunun hissedilmesi kaliteyi olumsuz yönde etkilemektedir. Sürme hastalığının kontrolünde tohum ilaçlamasının yapılmaması durumun da ortalama verim kayıplarının %15-20'e ulaşabileceği, tohumluğun ilaçlanmadan üst üste ekildiği bazı üretim sezonlarında ise verim kayıplarının %70-95'e ulaşabileceği bildirilmiştir (Özkan, 1964). Hastalık primer olarak tohumla taşınmakla birlikte, aynı zamanda önceki üretim sezonunda toprağa karışan hastalık sporlarının da konukçusunu hastalandırabildiği bilinmektedir. Hastalıkla savaşımda uygulanabilecek yöntem ve uygulamalar ayrıntılı olarak Zirai Mücadele Teknik Talimatlarında bulunmaktadır (Anonim, 2008). Hastalıkla savaşımda tavsiye edilen farklı teknikler tek olarak veya birbirleriyle entegre edilerek kullanılması mümkündür. Diğer taraftan üretici için ucuz ve pratik bir metot olması ve büyüyen organik ürün pazarı için genetik olarak dayanıklı olan çeşitlerin kullanımını öne çıkmaktadır. Diğer taraftan hastalıkla savaşım için öncelikle hastalığa dayanıklı çeşitlerin geliştirilmesi ve bu çeşitlerin üretim desenin de yer alması gerekmektedir.

Bu araştırmanın amacı; Tarla Bitkileri Merkez Araştırma Enstitüsü (TARM) Buğday Islahı Birimi tarafından farklı programlar için geliştirilmiş Ekmeklik Verim Denemesi Set-1 ıslah materyalinin 19 hat ve 6 standart çeşidin İkizce (Ankara) ekolojik koşulların da sürme hastalığına karşı reaksiyonlarının belirlenmesidir.

Materyal ve Yöntem

TARM Buğday Islah Birimi tarafından farklı amaçlara yönelik olarak geliştirilen ve yürütülen buğday ıslah programları ve materyalleri her yıl Orta Anadolu bölgesi veya benzer ekolojiler de görülen bazı önemli fungal hastalıklara karşı test edilmektedir. Ekmeklik Verim Denemesi Set-1 olarak tanımlanmış çalışma materyali 19 hat ve 6 standart çeşitten (Bayraktar 2000, Demir 2000, Tosunbey, Bezostaja-1, Kenanbey) oluşturulmuştur. Materyalin sürme hastalığına karşı reaksiyonları yapay epidemi altında test edilmiştir.

Reaksiyon çalışmaları Ankara-İkizce lokasyonunda (1150 m) bulunan TARM Araştırma ve Uygulama Çiftliği arazisi Hastalık ve Zararlılara Dayanıklılık Biriminin araştırma tarlasın da yürütülmüştür. Hastalığın inokulum kaynağı bir önceki yıl sürme hastalık test çalışmalarının yürütüldüğü tarladan toplanan enfekteli başaklardır. İnokulasyon çalışmalarında hastalıklı başaklar porselen bir havanda ezilmiştir. Ezilen başaklardan hastalık sporlarının elde edilmesi için eleme yapılmış ve sürme sporları elde edilmiştir. Araştırma materyali daha önce herhangi bir amaçla kullanılmamış kağıt zarflar içerisine yaklaşık 5-8 gram olacak şekilde konulmuştur. Yaklaşık %0,5 oranı göz önünün de tutularak hastalık etmenin sporları (Aktaş ve ark., 1995) tohum bulunan zarflarının içerisine konularak sporların tohumun sakal kısmına iyice yapışması için sağlanmıştır. Hastalık etmeniyle ekimden 1-2 gün önce bulaştırılan materyal yaklaşık 33 cm sıra arası mesafe ve 1 metrelik sıralara 2 tekerrürlü olarak 12 Kasım 2014 tarihinde elle ekilmiştir. Araştırma materyali ile aynı metotla inokule edilen ve ekilen hassas kontrol Little Club (LC) genotipi her 10 sıradan sonra bir olacak şekilde ve denemenin çevresine 6 sıra olacak şekilde LC ve Yakar-99 çeşidi ekilmiştir. Araştırmanın yürütüldüğü tarla da herhangi bir organik veya kimyasal gübre ile herhangi bir bitki koruma ürünü kullanılmamıştır. Değerlendirme başakların tam olarak olgunlaştığı 26 Temmuz 2015 tarihin de her sıradaki sağlam ve hastalıklı başaklar sayılarak yapılmıştır. Sonuçların değerlendirmesinde herhangi bir materyal için tekerrürler de ki yüksek olan % hastalık oranı dikkate alınmıştır. Değerlendirme için hastalığa reaksiyon açısında gruplandırma yapılarak hastalıklı başakların oranı ≤%25 olan materyaller dayanıklı (Çizelge 1) olarak belirlenmiştir (Akçura ve Akan, 2018).

Hastalığın ırk/ırklarının hangi dayanıklılık gen/genleri üzerine etkin olduğunun belirlene bilmesi amacıyla 17 genotipden oluşan ve farklı sürme dayanıklılık genlerini içeren ırk ayırıcı sette (Common Bunt Differential Set (CB-DIFF)) (Çizelge 2) test materyalleri aynı şekilde inokule edilmiş, ekilmiş ve değerlendirilmiştir. Hastalık reaksiyon gruplandırması test materyalinden farklı olarak Hoffman ve Kendric (1968) tarafından yapılan çalışma esas alınmıştır.

Araştırma Sonuçları

Her 10 materyalden sonra bir olacak şekilde ve denemenin çevresine ekilen hassas kontrol LC ve Yakar-99 genotipinde hastalık oranı %90-100 olarak belirlenmiştir. Bu değerlendirme yürütülen test çalışmalarının sonuçlarının "güvenilir" olduğu şeklinde yorumlanmıştır. Çalışmada reaksiyon gruplandırmasın da Akçura ve Akan, (2018) tarafından,

yapılan araştırma dikkate alınmıştır. Bu gruplandırmaya göre hastalıklı başak yüzdesi %0 İmmun, %0,1-10 Dayanıklı, %10,1-25 Orta Dayanıklı, %25,1-40 Orta Hassas, %40,1-70 Hassas ve %70,1-100 oranları ise Çok Hassas şeklinde yorumlanmıştır. Test materyalinin belirlenen reaksiyonları ve reaksiyon gruplarına dağılımı Çizelge 1'de verilmiştir. Hastalık reaksiyonu ≤%25 oranında olan materyal dayanıklı olarak değerlendirilmiş olup bu hatların sürme hastalığına dayanıklı olması nedeniyle seleksiyonun yapılması tavsiye edilmiştir.

Araştırma materyali hastalık reaksiyon gruplarına göre değerlendirildiğinde immun seviyede hat belirlenemezken, 1 (%5) hat dayanıklı, 2 (%11) hat orta dayanıklı olarak gruplandırılmıştır. 3 (%16) hat orta hassas, 2 (%11) hat hassas, 11 (%58) hat çok hassas olarak gruplandırılmıştır (Çizelge 1). Araştırma materyalinde yer alan tüm standart çeşitler Bayraktar 2000, Demir 2000, Tosunbey, Bezostaja-1, Kenanbey hassas grup da (≥%25,1) yer almıştır

Çizelge 1. Araştırma materyalinin hastalıklı başak % oranına göre reaksiyon gruplandırılması ve hatların bu reaksiyon gruplarına %'lik dağılımı

	% 0	% 0,1-10	% 10,1-25	% 25,1-40	% 40,1-70	% 70,1+	Toplam
	İmmun	Dayanıklı	Orta Day.	Orta Has.	Hassas	Çok Hassas	
Hat Sayısı	0	1	2	3	2	11	19
% Hastalık	0	5	11	16	11	58	100

Çalışma materyali ile birlikte değerlendirilen sürme hastalığı ırk ayrıcı setin içinde yer alan genotipler ve içerdiği dayanıklılık genleri Çizelge 2 de verilmiştir. Test edilen hastalık populasyonuna karşı hangi sürme dayanıklılık gen/genleri aktif/etkin olduğu da bu çalışma ile belirlenmiştir.

Çizelge 2. Hastalık popülasyonun yapay epidemi altında etkin olduğu dayanıklılık gen/genler

Dayanıklı olarak belirlenen genler		Hassas olarak belirlenen genler	
Genotip	İçerdiği Gen	Genotip	İçerdiği Gen
SEL 2092	Bt-1	Heines VI	Bt-0
Hohenheimer	Bt-5	SEL 1102	Bt-2
M78-9496	Bt-8	Ridit	Bt-3
M82-2098	Bt-9	Turkey 1558	Bt-4
M82-2102	Bt-10	Rio	Bt-6
P.I. 178383	Bt-8,9,10	Sel 50077	Bt-7
M82-2123	Bt-11		
P.I. 119333	Bt-12		
P.I. 181463	Bt-13		
Doubi	Bt-14		
Carlton	Bt-15		

Tartışma

Tuncel (2006) ile Aktaş ve Katırcıoğlu (2008) tarafından yürütülen farklı araştırmalar da Bezostaja-1 çeşidi sırasıyla orta hassas veya hassas olarak belirlenmiş olup bu durum çalışmamızla örtüşmektedir. Diğer taraftan Rodenhisar ve Holton (1942), tarafından yapılan bir çalışma sonucunda yetiştiricilik ve çevre koşullarında meydana gelebilecek olası farklılığın bazı genotiplerde farklı sürme ırk/ırklarına karşı reaksiyonlarında bazı değişiklikler oluşturabileceğini bildirmişlerdir. Bu durumun konukçu yönüyle protoplazmik dayanıklılığının farklı genotipler de yetiştiricilik ve çevrenin gösterdiği etkinin patojenden çok konukçuyla ilgili olduğunu bildirmişlerdir. Ayrıca yine Rodenhisar ve Taylor (1940) tarafından yürütülen bir çalışma da toprak yapısı ve inkübasyon sıcaklığı arasında meydana gelen değişimi incelemişlerdir. Konukçu genotipin sürme ırkına karşı gösterdiği reaksiyonun, üretim sezonundan üretim sezonuna veya bir yetiştiricilik şartından diğerine

değişiklik göstermesine neden olabileceği sonucu varmışlardır. Bu durum dayanıklı grupta yer alan genotiplerin farklı üretim sezonu ve lokasyonlarda tekrar test edilme gerekliliğini ortaya koymaktadır. Bu nedenle dayanıklı grup da yer alan materyal farklı yıllar ve lokasyonlarda tekrar test edilmelidir.

Gerek çeşit geliştirme çalışmalarında gerekse bu çalışmayla dayanıklı grup da belirlenen ıslah kademesi materyalinin Islah, Kalite ve Dayanıklılık Islahı gruplarınca yürütülecek çalışmalarla verim, agronomik özellikleri, kalite ve biyotik ve abiyotik stres faktörlerine karşı reaksiyonları belirlenmelidir. Seleksiyon çalışması ile ıslah amacına yönelik olarak geliştirilmiş olan materyal öncelikle Orta Anadolu Bölgesi için veya benzer yetiştiricilik çevrelerinde genotiplerin tescil ettirilebilmesi mümkündür. Dayanıklı olarak belirlenen genotipler "Sürme hastalığına dayanıklılık kaynağı" özel bir germplasma dahil edilmiştir. Geliştirilen bu kaynak; çeşit geliştirme ve üretim programları yürüten ulusal ve uluslararası araştırma kuruluşlarınca dayanıklılık ıslah çalışmalarında kullanılabilir.

Sürme hastalığı çalışmaların da yetiştiricilik alanlarında yeni ırk/ırkların belirlenmesi ve virulens değişimlerinin izlenmesi üzerinde önemle durulması gereken konular arasındadır. Olabilecek virülens değişimleri ve çözüm önerileri belirlendikten sonra yürütülen ıslah programlarının genel yapısını bozmadan revizyon çalışmaları yapılarak kabul edilebilir düzeyde dayanıklı yeni genotiplerin geliştirilmesi mümkündür.

Sürme hastalığın kontrol edilmesinde üretici tercihi öncelikli olarak tohum ilaçlaması olup bu yöntem etkili ve ekonomiktir. Ülkemizde her geçen gün ilaçlı veya sertifikalı tohum kullanımının artarak devam etmesi sürme hastalığının görülme sıklığını ve zararının ilerleyen yıllarda azalması beklentisini beraberinde getirmektedir.

Teşekkür: Bu çalışma, Tarımsal Araştırma ve Politika Genel Müdürlüğü tarafından finanse edilmiş ve desteklenmiştir (Proje No: TAGEM/TA/12/03/01/001).

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YULAF VERİM DENEMESİ SET-3 MATERYALİNİN KARA PAS HASTALIĞINA REAKSİYONLARININ BELİRLENMESİ

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ÖZ

Yulaf; düşük maliyetli üretim ve tanesinin besin özelliklerinin istenilen yönde olması nedeniyle, diğer serin iklim tahıllarıyla karşılaştırıldığında, kahvaltılık olarak ve evcil hayvanların beslenmesinde kullanımı giderek artmaktadır. Kara pas hastalığı, fungal bir etmen olan *Puccinia graminis* Pers. f. sp *avenae* Erikss. & Henn. tarafından oluşturulan yaprak ve gövde de görülen önemli bir hastalıktır. Hastalık enfeksiyonu sonucu verim ve kalite kayıpları oluşmaktadır. Genetik dayanıklılık hastalığın kontrolünde genellikle tercih edilmektedir. Bu çalışmanın amacı, Bahri Dağdaş Uluslararası Tarımsal Araştırma Enstitüsü tarafından geliştirilen 70 yulaf genotipinin sera ve ergin evrelerinin kara pas hastalığına karşı reaksiyonlarının belirlenmesidir.

Sera evresi (fide dönemi) testleri İkizce (Ankara) ve Seydiler (Kastamonu) lokasyonlarından elde edilen izolatlarla yapılmıştır. Materyal Zadoks skalası 11-12 evresinde inokule edilmiştir. Değerlendirme inokulasyondan 14 ve 16 gün sonra 0-4 sklası kullanılarak yapılmıştır. Tarla evresi (ergin bitki) test çalışmaları İkizce (Ankara) ve Seydiler (Kastamonu) lokasyonunda doğal epidemi altındagerçekleştirilmiştir. Değerlendirme Haziran-Temmuz 2015 tarihin de Modifiye Cobb skalası kullanılarak yapılmıştır. ≤20 Enfeksiyon kat sayısı olan materyal dayanıklı olarak belirlenmiştir

Sonuç olarak; 52 (%74) genotip hem fide hem de ergin bitki evresinde dayanıklı olarak belirlenmiştir. Dayanıklı olarak belirlenen materyaller dayanıklı çeşit olarak tescil ettirilebilir veya dayanıklılık ıslah programlarında dayanıklı genitor olarak kullanılabilir.

Anahtar kelimeler: Yulaf, kara pas (*Puccinia graminis avenae*), reaksiyon testi, dayanıklılık ıslahı

Determination of the Reactions of Oat Yield Trial-3 Set to Stem Rust

ABSTRACT

Oat; Due to the low cost of production and the desired nutrients of the grain, the use of food for breakfast and domestic animals is increasing compared to other cereals. Stem rust caused by *Puccinia graminis* Pers. f. sp *avenae* Erikss. & Henn. is the most devastating foliar and stem fungal disease in oats. Important yield and quality losses result from stem rust infection. Genetic resistance is generally preferred primarily in the control of stem rust. The purpose of this study was to determine the seedling/greenhouse and field/adult plant reactions of 70 oat materials developed by the Bahri Dağdaş International Agricultural Research Institute. In the greenhouse experiments of materials (seedling test) was conducted at Yenimahalle (Ankara) location with an isolate obtained Seydiler (Kastamnonu) location. Test materials were inoculated at Zadoks Growth Stage-11 or 12. Reactions were scored for each entry at 14 and 16 days' post-inoculation on standard 0-4 scales. In the filed experiments of materials (adult plant test) was conducted under natural epidemic condition in Seydiler location. Disese was scored on the Modified Cobb scale in June-July, 2015 and Coefficients of Infection ≤20 were considered to be resistant. As a result; 48 (96%) genotypes were resistant at both seedling and adult plant stage. Resistant genotypes in field were also found as resistant at seedling stage. The results indicate that 48 materials to stem rust diseases in the germplasm and these materials can use in the resistance breeding or breeding programmes.

As a result; 52 (74%) genotypes were determined to be resistant to both seedling and adult plants. The material determined to be durable may be registered as a resistance cultivar or used as resistance genitor in resistance breeding programs.

Key words: Oats, stem rust (*Puccinia graminis avenae*), reaction test, resistance breeding,

Giriş

Günümüzde üretimi yapılan yulaf (*Avena sativa L.* ve *Avena byzantina Koch.*) diğer serin iklim tahıllarıyla karşılaştırıldığında üretim maliyetinin düşük olması nedeniyle üretimi her geçen gün artmaktadır. Türkiye'de yulaf yaklaşık 105.8 bin ha alanda yetiştrilmekte olup, 260 bin ton üretim yapılmış ve ortalama verim 246 kg/da'dır (TUİK, 2018). Yulafın tanesinin besin özelliklerinin istenilen yönde olması nedeniyle, kahvaltılık olarak ve evcil hayvanların beslenmesinde kullanımı giderek artmaktadır. Yulafın tarımsal özelliklerinin istenilen yönde geliştirilerek çeşit geliştirme çalışmaları devam etmekte olup tane verimi, bazı kalite özellikleri ile biyotik ve abiyotik stres faktörlerine karşı kabul edilebilir düzeyde dayanıklılık ıslah çalışmalarının bazı konularını oluşturmaktadır. Fungal bir etmeni olan *Puccinia graminis* Pers. f. *sp avenae* Erikss. & Henn. tarafından oluşturulan kara pas hastalığı yaprak, gövde ve salkımlarda de görülen bir hastalıktır. Kara pas hastalığı tüm yulaf üretim alanlarında görülebilmek de olup değişen düzeylerde verim ve kaliteyi olumsuz yönde etkileyebilmektedir. Genel olarak pas hastalıklarının savaşımda kullanılacak yöntem ve uygulamalar Zirai Mücadele Teknik Talimatlarında bildirilmiştir. (Anonim, 2008). Kontrol yöntemleri arasında yer alan "dayanıklı çeşit kullanımı" üretici için diğer kontrol metotları ile karşılaştırıldığın da birçok açıdan memnun edicidir. Örneğin üretici için ucuz, kolay uygulanabilir ve insan/çevre sağlığını üst düzeyde korumaktadır.

Araştırmanın amacı; Orta Anadolu veya benzer ekolojik yetiştiricilik şartlarına uygun, istenilen seviye de verimli, kaliteli ve kara pas hastalığına kabul edilebilir düzeyde dayanıklı çeşit adayı genotiplerin geliştirilmesine katkı sağlanmasıdır. Çalışmayla Bahri Dağdaş Uluslararası Tarımsal Araştırma Enstitüsü tarafından geliştirilen 70 yulaf genotipinin sera ve ergin evrelerinin kara pas hastalığına karşı reaksiyonları belirlenmiştir.

Materyal ve Yöntem

Bahri Dağdaş Uluslararası Tarımsal Araştırma Enstitüsü Müdürlüğü (BDUTAEM) Islah-Genetik Bölümünce klasik ıslah metotları ile geliştirilen 70 hat (Kademe Verim Materyali; Set-3) ile 5 standart çeşit (Yeniçeri, Seydişehir, Kahraman, Chekota, Faikbey) çalışmanın materyalini oluşturmaktadır. 2014-2015 üretim sezonunda yapılan çalışmanın fide evresi testleri Tarla Bitkileri Merkez Araştırma Enstitüsü Müdürlüğü Ankara Yenimahalle lokasyonunda bulunan sera şartlarında 3 tekerrürlü, ergin dönem testleri Ankara İkizce ve Kastamonu Seydiler lokasyonların da 2 tekerrürlü olarak yürütülmüştür.

Fide evresi çalışmalarında öncelikle etmeninin İkizce ve Seydiler lokasyonlarından alınan izolatları Mert ve ark. (2011) tarafından bildirilen protokole benzer şekilde tek püstülden çoğaltılmıştır. Üretilen tek püstüllerden yeterli inokulum miktarı elde edilinceye kadar izolatlar birbirine karışmayacak şekilde sera şartlarında üretilmiştir. Test materyalleri 7X7 cm ebatlarında ki plastik kaplara her bir saksı da dört genotip olacak şekilde ekilmiş ve 20-25ºC'de yetiştirilmiştir. Etmenin sporları uçucu madeni yağ içerisinde süspanse edilmiş ve materyal Zadoks skalası 11-12 evresinde (Zadoks, 1963) inokule edilmiştir. 24 saat süreyle 22+3ºC'de %90-95 nem ortamında tutulan test materyali, bu süre sonunda 20-25ºC' şartlarında ki serada yetiştirilmeye devam edilmiştir. İlk değerlendirme, inokulasyonu takip eden 15. Gün, ikinci değerlendirme birinci değerlendirmeden 2 gün sonra enfeksiyon tiplerini esas alan 0-4 skalasına (Stakman ve ark., 1962) göre yapılmıştır.

Ergin bitki evresi çalışmaları İkizce (Ankara) ve Seydiler (Kastamonu) lokasyonunda doğal epidemi altında gerçekleştirilmiştir. Test materyalleri yaklaşık 30-35 cm sıra arası ve 1 metre uzunluğunda ki sıralara elle ekilmiştir. Çalışma doğal epidemi şartlarında yürütüldüğü için herhangi bir inokulasyon işlemi yapılmamıştır. Değerlendirmeler Modifiye Cobb skalası (Peterson ve ark., 1948) ve reaksiyon tipi birlikte kullanılarak yapılmış olup hassas materyaller 90-100 S düzeyine ulaştığında yapılmıştır. Temmuz ayı içinde en az 2 defa yapılan değerlendirmeler de yüksek skor alınmıştır. Enfeksiyon Katsayısı (EK) hesaplanmış ve seleksiyon çalışması için tavsiye de bulunulmuştur.

Araştırma Sonuçları

Fide evresi çalışmalarında yerel hassas kontrol genotipi 3+ skala değeri ile değerlendirilmiştir. Bu değerlendirme çalışmanın güvenilir bir şekilde gerçekleştirildiğinin bir göstergesi olarak kabul edilmiştir.

Tekerrürlerde ki en yüksek skala değeri değerlendirmeye alınmıştır. Standart çeşitler hariç fide evresinde İkizce izolatı için 58 (%83) genotip dayanıklı (0-2 skala değeri), 12 (%17) genotip ise hassas (3-4 skala değeri) olarak belirlenmiştir. Standart çeşitlerden Chekota, Yeniçeri, Kahraman dayanıklı Faikbey, Seydişehir hassas olarak değerlendirilmiştir. Seydiler izolatı için 53 (%76) genotip dayanıklı (0-2 skala değeri), 17 (%24) genotip ise hassas (3-4 skala değeri) olarak belirlenmiştir. Standart çeşitlerden Yeniçeri, Kahraman dayanıklı Chekota, Faikbey, Seydişehir hassas olarak değerlendirilmiştir.

Tarla evresi çalışmalarında yerel hassas kontrol genotipi İkizce lokasyonda 40-60 S olarak değerlendirilmiştir. Hassas kontrol çeşidi istenilen düzeyde hastalık gelişmediği için değerlendirme yapılmadan çalışmanın bu kısmı iptal edilmiştir. Bununla birlikte 50 S ve üzerinde skorla değerlendirilen materyallerin deneme materyalleri içinden çıkarılması yönünde tavsiyede bulunulmuştur. Diğer taraftan yerel hassas kontrol genotipi Seydiler lokasyonun da 90-100 S olarak değerlendirilmiştir. Bu durum çalışmanın güvenilir olduğunun göstergesi olarak kabul edilmiştir. Seleksiyon çalışması için yapılan değerlendirmeler de tekerrürlerde ki en yüksek değer dikkate alınmıştır. Araştırma materyalinde 60 (%86) genotip dayanıklı (EK 0-20) 10 genotip (%14) hassas (EK; 20,1-100) olarak belirlenmiştir (Akan ve Akçura, 2018). Standart çeşitlerden Yeniçeri, Kahraman dayanıklı (EK; 0-20) Chekota, Faikbey, Seydişehir hassas olarak (EK; 20,1-100) değerlendirilmiştir.

İkizce ve Seydiler lokasyonlarından toplanan izolatlara karşı yapılan sera testleri ile Seydiler lokasyonunda yapılan tarla evresi çalışmaları birlikte değerlendirildiğinde; sera evresinde dayanıklı grupta (0-2 skala değeri) yer alan 52 (%74) genotipin hepsi tarla evresinde de dayanıklı grupta (EK; 0-20) yer almıştır. Bununla birlikte sera evresinde hassas olan 1 genotip tarla evresinde dayanıklı olarak değerlendirilmiştir. Benzer şekilde standart çeşitlerden Yeniçeri ve Kahraman hem sera hem tarla evresinde dayanıklı olarak değerlendirilmiştir. Sera evresinde hassas olup tarla evresinde dayanıklı olarak belirlen materyallerin ergin dönemde aktif olan dayanıklılık gen/genlerinin bulunması, bir gen veya birden fazla genin dayanıklılık mekanizmasında yer alması ya da bitkinin morfolojik yapısından kaynaklanan özelliklerinden kaynaklana bilir.

Tartışma

Yulaf da kara pas hastalığı Orta Anadolu üretici şartlarında epidemi şartlarının oluştuduğu durumda üründe verim ve kalite kayıplarına neden olarak değişen ekonomik kayıplara yol açabilmektedir. Kara pas hastalığının kontrolünde dayanıklı çeşitlerin üretim alanlarında üretilmesi üretici için en uygun yaklaşımlardan birisidir. Çalışmayla tarla evresinde dayanıklı olarak belirlenen genotiplerin verimli, kaliteli ve diğer özelliklerinin istenilen yönde olması durumunda Orta Anadolu yetiştiricilik şartlarında üretilebilecek amaca uygun olan genotipler tescil ettirilebilir. Diğer taraftan sera ve tarla şartlarında dayanıklı olarak belirlenen 52 genotipin bir üst kademeye aktarılması ve kara pas hastalığına dayanıklılık kaynağı olarak kullanılması tavsiye edilmiştir.

Tarla evresinde seleksiyon çalışmalarına erken kademe de (F3) başlanması dayanıklılık ıslah çalışmalarının hedefe ulaştırılmasında başarıyı arttıracaktır. Pas hastalıklarının virülensliğinde ortaya çıkabilecek değişimler göz ardı edilmemelidir. Bu nedenle tescil ettirilen çeşitler, çeşit adayı genotipler ve dayanıklılık ıslahında kullanılan dayanıklı genitör genotiplerin her yıl çoklu lokasyonda hastalık testlerinin yapılması gerekmektedir. Irk değişiminin belirlenmesi durumunda oluşan yeni durum için ıslah programlarının kısa sürede revize edilmesi hastalığa dayanıklılığın sürekliliğinin sağlanması için önemlidir.

Teşekkür: Bu çalışma, Tarımsal Araştırma ve Politika Genel Müdürlüğü tarafından finanse edilmiş ve desteklenmiştir (Proje No: TAGEM/TA/12/03/01/001).

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ORAL PRESANTATION ABSTRACT

TÜRKİYE'DEKİ MAKROMANTAR CALISMALARI VE PROF.DR. KENAN DEMİREL' İN ALANA KATKILARI

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ABSTRACT

Türkiye, bir bütün olarak iklim ve bitki örtüsü bakımından makromantar gelişimi için çok uygun ortamlara sahiptir. Ülkemizin makromantar çeşitliliğinin tespiti için 1852 yılından bugüne kadar yapılan çalışmalar sonucunda 2500 civarında makromantar türü tespit edilmiştir. Konu ile ilgili çalışmalar halen devam etmektedir. 1988 yılında lisansüstü eğitimi ile makromantarlar üzerinde çalışmaya başlayan Prof. Dr. Kenan DEMİREL özellikle ülkemizin Doğu Anadolu ve Doğu Karadeniz bölgesi başta olmak üzere birçok çalışma yapmış ve Lisansüstü öğrenci yetiştirerek ülkemiz makromantar çeşitliliğinin belirlenmesine katkı sunmuş olup 10.02.2019 tarihinde aramızdan ayrılmıştır.

Key words - Türkiye, Makromantarlar, Prof. Dr. Kenan DEMİREL.

IUCN RED LIST OF THREATENED SPECIES SELECTED FUNGI ON JUNIPERS FROM BALKANS AND TURKEY

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ABSTRACT

The urgency to incorporate fungi into nature conservation overall has been the cause to commence an ongoing process called the Global Fungal Red List Initiative. This Initiative seeks to assess and document no less than 1,500 fungi by 2021 and facilitate and synchronise joint effort by the global mycological community to have at least 500 species of threatened fungi assessed and classified as globally red-listed. Thus far, there are 56 fungi species that have been globally evaluated under the IUCN Red List criteria, whereof 13 are lichens or lichen associates. Forty-three species thereof have been listed as 'threatened', 6 as 'critically endangered', 18 'endangered' and 20 'vulnerable'. This paper deals with rare and endangered species of fungi from the Balkans and Turkey that are hosted by juniper trees. These are species proposed or assessed in the Global Fungal Red List Initiative or categorized and published on the website of the global IUCN Red List of Threatened Species. Specifically, of the four fungal species occurring exclusively on species from the genus *Juniperus* and proposed via the Global Fungal Red List Initiative, one has already been published and categorised in compliance with the global IUCN Red List of Threatened Species. The species in question is *Lenzitopsis oxycedri* (VU) whereas the species *Hyphoderma etruriae* and *Xeromphalina junipericola* have been accepted and their publication is imminent. The remaining species, such as *Antrodia juniperina, Mycena juniperina, Inonotus sulphurascens, Pyrofomes demidoffii* and *Velutyceps berkeleyi* are currently in the assessment phase and their evaluation is pending. All species quoted have been collected on *Juniperus excelsa* and *J. foetidissima* from the Balkan Peninsula and Turkey as a result of a bilateral scientific project, entitled Macromycetes Biodiversity in Juniper Forest (Juniperus excelsa and Juniperus foetidissima) in Turkey and Macedonia and Their Comparison, Karadelev & Dogan (2003-2004). A number of species, for instance, *Antrodia juniperina*, *Lenzitopsis oxycedri*, *Mycena juniperina*, *Pyrofomes demidoffii* and *Xeromphalina junipericola* are on the Red List of Fungi of Macedonia listed as 'critically endangered' while the species *Antrodia juniperina* and *Pyrofomes demidoffii* are part of the Red List of Fungi of Bulgaria categorised as 'endangered'. *Inonotus sulphurascens* and *Velutyceps berkeleyi* are extremely rare species known only from Turkey.

Key words - IUCN Red List, fungi conservation, juniper, Balkans, Turkey

WHERE DO WE STAND IN UNDERSTANDING THE BOLETE DIVERSITY OF EUROPE AND THE ADJACENT REALMS

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ABSTRACT

Since a long time, the boletes and their allies have been one of the most intensively studied groups of fungi in Europe, partly due to their attractive appearance and partly because of their useful properties. The emergence and the refining of the molecular techniques in the last decades has introduced major changes in our understanding of the bolete taxonomy and systematics, leading to the first natural system of this important fungal group. The DNA studies also revealed a number of new species in Europe, as well as cryptism, previously not recognized by the traditional approaches. The present talk will review the current advance in the bolete taxonomy by examples from different groups of the order Boletales. Besides, apart of the increasing number of molecular studies, some major gaps in the bolete knowledge on this continent still persist and wait for taxonomists' attention. The most important of these will be also summarized and discussed.

Key words - Boletaceae, Boletales, taxonomy, systematics

A NEW RECORD FOR MYCOTA OF TURKEY

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ABSTRACT

As a result of the field studies carried out in 2016 within the boundaries of Sarıkamış Allahuekber Mountains National Park (Kars/ TURKEY) macro fungi specimens were collected. Morphological, ecological and ethno mycological features of collected specimens were recorded and photographs were taken in their natural habitats. Microscopic features were determined by applying necessary mycological techniques to the specimens carried in the laboratory. The specimens were identified according to tohe information obtained from field and laboratory studies. As a result, it was determined that the *Marasmius collinus* (Scop.) Singer species has not been previously identified in our country, thus this is new record for the mycobiota of Turkey. The identified samples were deposited at the Fungarium of Van Yüzüncü Yıl University, Faculty of Science, Department of Biology (VANF). We would like to thank Van Yüzüncü Yıl University, Scientific Research Projects Coordination Unit for financially supporting this study within the scope of project 2012-FBE-D051.

Key words - New record, mycota, Turkey, Marasmius

POROID AND CORTICIOID FUNGI OF UZBEKISTAN CENTRAL ASIA

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ABSTRACT

Uzbekistan is one of the most diverse regions in the world with respect to both fauna and flora and is regarded as a remarkable collection of many relicts and endangered plant species. There have been sparse studies on fungi in Uzbekistan, but there is still no comprehensive study or even preliminary estimation of the total fungal diversity in Uzbekistan and other Central Asian countries. Poroid and corticioid fungi are one of the major groups of wood-inhabiting basidiomycetes, although some of them are mycorrhizal fungi. Most of them are major wood decomposers causing brown and white rots of wood decay, and they play important roles in nutrient cycling and soil formation in forest ecosystems, while some of them are known as serious pathogenic disease agents of ecologically and economically important coniferous and deciduous woody plants. This study was based on bibliographic research, recheck of fungi exsiccates specimens in TASM (3 specimens), TAAM (96 specimens) herbariums and fresh specimens (166 specimens) collected from urban and mountain forests around study region and identified by morphological and molecular methods. In molecular identification of the specimens, ribosomal ITS, LSU fragments and also TEF geneDNA were sequenced and compared with those deposited in NCBI GenBank database. Here we report 154 species belonging to 10 orders, 25 families and 95 genera of aphyllophoroid fungi for Uzbekistan. Among them, 33 species are reported for the first time in Uzbekistan and Central Asia. The most species-rich families are Polyporaceae (41 species), Hymenochaetales (28), Fomitopsidaceae (21) and Meruliaceae (14) and contain 104 species that constitutes 67.6% of the total species number. The largest genera are Trametes (8 species), Inonotus (7), Phellinus (5), Lentinus (4), Stereum (4), Antrodia (4) that contain 20 species or 20.7% and the other genera have one to three species. Most frequently poroid and corticoid were found on host plants/substrates of the families Salicaceae (71 species), Pinaceae (50), Rosaceae (47), Fagaceae (30), Juglandaceae (29), Betulaceae (25), Cupressaceae (15), Ulmaceae (11), Sapindaceae and Oleaceae (each 10) and other families have one to nine species. The highest number of poroid and corticoid species is reported in the following host genera: Populus (42 species), Quercus (29), Juglans and Pinus (each 28), Betula (20), Picea (19), Prunus (16), Malus (13), Juniperus (12), Ulmus (11), Acer (10) and other host genera remain by nine to one fungal species. One hundred and twenty-four poroid and corticoid species found on deciduous and 36 species on coniferous wood, seven species were found in both kinds of woody plants, and the substrates were not determined for the remaining 15 species. Among the poroid and corticioid fungi, 20 species are associated with a wide range of tree-hosts such as *Stereum hirsutum* (12 host species), *Trametes versicolor* and *Phellinus pomaceus* (11), *Lentinus tigrinus* (10), *Cerrena unicolor* (9). *Bjerkandera adusta, Trametes hirsuta, Tropicoporus linteus* (each 8), *Schizophyllum commune, Coriolopsis gallica, Trametes tephroleuca, Trametes trogii* (each 7), *Fomitiporia robusta* (each 7), *Irpex lacteus, Laetiporus sulphurous, Fomes fomentarius* (each 6), *Antrodia xanthan, Cellulariella warnieri, Trametes gibbosa* and *Fuscoporia torulosa* (each 5). One hundred and thirty-four of wood-inhabiting poroid and corticoid species are represented by four to one host species each. Since forest tree species diversity is greater in Central Asia, it is likely that greater numbers of wood-decaying fungi would be found in this area. Additional surveys and basidiocarp identification is needed in this area of Uzbekistan to obtain a more precise assessment of the major wood decay fungi that may be found.

Key words - biodiversity, ITS, nLSU, TEF, wood-inhabiting fungi, taxonomy

BIODIVERSITY OF HEAT RESISTANCE SOIL FUNGI IN AGRICULTURAL AREAS OF ESKISEHIR PROVINCE

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ABSTRACT

Heat-resistant microfungi can survive 30 minutes of heat at 75°C and can continue to develop and deteriorate products during storage in the room conditions. The most important role in this heat resistance is based on the ability to form sexual reproduction structures called as ascospores, and heat resistance of ascospores depends on species, strain, pH, heating medium and other growth. *Byssochlamys fulva* (current name; *Paecilomyces fulvus*) is the first recorded heat-resistant microfungus, and in addition to *B. nivea* (current name; *Byssochlamys laguncullariae*), *Neosartorya fischeri* (current name; *Aspergillus fischeri*), *Talaromyces macrosporus, T. bacillisporus* and *Eupenicillium brefeldianum* (current name; *Penicillium dodgei*) are the most common heat resistant microfungi. We examined the biodiversity of heat resistant microfungi in agricultural soils of Eskisehir Province in this study. For this purpose, four different soil samples were collected from fallow lands in east, west, north and south locations of Eskişehir Province between September 2017 and June 2019. Isolation process was performed by using soil dilution method after heat treatment at 75 °C for 30 minutes of diluted soil samples. After incubation at 30 °C for 7-14 days and purification of all colonies, isolates were diagnosed by using conventional methods and multi locus gene sequencing. We determined total of 322 colonies appertain to heat resistant microfungi and 49 species belong to *Aspergillus, Paecilomyces, Penicillium* and *Taloromyces* genera. As a result, we determined that the agricultural soils have high heat resistance microfungal biodiversity that commonly known as mycotoxigenic, pathogenic and saprophytic.

Key words: Heat resistant microfungi, agricultural soils, Eskişehir, multi locus gene sequencing.

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A NEW RECORD FOR TURKISH RUTSTROEMIA

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ABSTRACT

Genus Rutstroemia includes approximately 75 species especially temperate region. According to literatre on Turkish mycobiota, 2 species of the genus have thus far been recorded in Turkey. Ascomata were collected from Bolu province in June 2019. Identification of the fungal samples was conducted according to conventional and molecular methods (ITS region of the rDNA). Based on the high sequence similarity of the new record with *Rutstroemia elatina* (Alb. & Schwein.) Rehm, the relevant specimen is considered to be *R. elatina*. A molecular phylogenetic tree, short description, ecology, distribution and photographs related to macro and micromorphologies of the species are provided and discussed briefly. Acknowledgments We are thankful to TUBİTAK (Project no: 217z038) for its financial support.

Key words - Rutstroemia, new record, Turkey

SINGLE NAME NOMENCLATURE OF FUNGI AND ITS SOME REFLECTIONS SINCE 2011 ESPECIALLY IN TURKEY

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ABSTRACT

Despite some opposing mycologists in the fungal systematics, dual nomenclature (*meaning that a perfect i.e. sexually reproducing fungal species different name, the same species as an imperfect i.e. that fungus has asexual reproduction different name given*) was quitted along with publishing "The Amsterdam Declaration on Fungal Nomenclature". Developments related to the subject since 2011 and the effects of the single fungal taxonomic system are discussed. Full implementation of the single name nomenclature system may take a long time. It is difficult to abandon the fungal names in the publications before 2013, and these sources are still used in all over the world. Change can take place over time. It is seen that the old name of some species whose name is changed is still used in many publications.

Key words: Fungal taxonomy, single name nomenclature, one fungus one name.

RHABDOSPORA VISCI A POTENTIAL BIOCONTROL AGENT OF *VISCUM ALBUM*

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ABSTRACT

Viscum album (European mistletoe), is an evergreen, perennial, epiphytic, hemiparasitic shrub that lives on a wide range of woody plant species (Zuber 2004). European mistletoes can affect their host trees in many ways. Known effects include that mistletoe infections lower the vigor of the host, induce premature mortality, reduce the quality and quantity of wood produced, reduce fruiting of infected trees and predispose trees to be attacked by other agents, such as insects or decay fungi (Hawksworth 1983). Plant specimen infected with microfungi was collected from Yedi Göller National Park in Bolu province of Turkey and prepared according to established herbarium techniques. Microscopical features were examined and microphotographs were made using a Leica DM E light microscope. The microfungi were identified using relevant literature. The examined specimens have been deposited in the mycological collection of the Ahi Evran University, Arts and Sciences Faculty, Mycology Laboratory in Kırşehir province of Turkey. Biological control of parasites by using plant pathogens has gained acceptance as a practical, safe and environmentally beneficial management method applicable to agro-ecosystems (Charudattan 2001). Control of European mistletoe is an important problem for the forest service in Turkey (Yüksel et al. 2005). Over 20 microscopic fungi live on European mistletoe, but only a few of them cause major damage on the plant (Karadžić et al. 2004). Of these, *Rhabdospora visci*, which causes leaf spot disease of European mistletoe appears to have potential as a biological control agent against of this semiparasite. In this study; *Rhabdospora visci* on living leaves of *Viscum album* subsp. abietis is reported as new to the mycobiota of Turkey. Acknowledgments: This work was supported by the TUBİTAK (Project Number: 217Z038).

Key words - New record, microfungi, Turkey

DETERMINATION OF ANTIFUNGAL ACTIVITY OF TICK EGG WAX

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ABSTRACT

The prevalence of fungal infections, which are widespread throughout the world, have increased markedly in recent years. Resistance associated with widespread and irregular use of antifungals which are relatively limited number, is seen as one of the main causes of the problem. It has been reported that the condition of fungal infection makes it necessary to search for new and effective drugs, and this requirement is predicted to increase over time. At this point, it was reported that plant or animal natural substances are the most important sources in the search for new drug alternatives. Studies on ticks in which many bioactive molecules with antimicrobial, anticarcinogenic and other properties have been isolated demonstrate that this arthropod group can be exploited for many purposes. The antibacterial, antimycotic and antiviral activity of the tick egg wax has been examined and some striking results have been obtained. On the other hand, the number of studies and ticks used in this study area is limited; however, there are hundreds of tick species and it is well known that the antimicrobial efficacy of the wax is closely related to the species of ticks. In this study, egg wax of *Hyalomma marginatum, Rhipicephalus bursa* and *Dermacentor marginatus* collected from different regions were extracted. Antifungal activities of egg wax on *Candida albicans* (ATCC 10231), *Candida parapsilosis* (ATCC 22019) and *Candida tropicalis* (ATCC 750)reference strains were determined by microdilution method according to CLSI M27-A3 recommendations. It was found that the wax of *R. bursa* showed an inhibitory effect on *C. tropicalis* (ATCC 750) at a certain concentration (625 µg/ml) and no effect was observed in other experiments. As a result; the effect obtained from the related species associated with its biological and ecological characteristics, and it has been concluded that significant results can be obtained in the name of a new generation antifungal discovery from studies standardized in more detail and more effectively with the tick species sharing such and similar biological and ecological characteristics especially with this species.

Key words - Candida, natural antifungal, tick egg wax, *Rhipicephalus bursa*

VARIATION IN THE DISTRIBUTION OF CANDIDA SPECIES IN BLOOD URINE AND VAGINAL CULTURES WITH IN TWO YEARS

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ABSTRACT

Candida species are the most common opportunistic fungal pathogen causing human infections and *C. albicans* is the most prevalant species. Despite the predominance of *C. albicans*, the frequency of non-albicans Candida (NAC) species has been shown to increase in the past decades. Knowledge of the frequency of causative species can provide guidance for empirical antifungal therapy. Therefore in this study, we aimed to investigate the variation in the distribution of Candida species isolated from blood, urine and vaginal samples between September 2017 and July 2019 in İstanbul Okan University Hospital Central Laboratory. Clinical samples were inoculated on Sabouraud Dextrose Agar and incubated at 37oC. Yeast colonies were subjected to germ tube test and inoculated on corN meal agar with Tween-80 (Dalmau plate). Strains producing germ tubes and chlamydospoes were identified as *C. albicans.* VITEK2 (Biomérieux, France) YST automated system were used for identification of NAC species. A total of 157 strains were obtained from 121 patients who were hospitalized in different wards. The rate of NAC species increased from 33.3% to 82.8% (mean 68.8%) in urine and from 50% to 70.6% (mean 64.4%) in vaginal cultures. *C. albicans* was the predominant species (mean 74.3%) isolated from blood cultures with NAC species accounting for only a quarter (25.7%) of candidemias and no significant change has been observed in time. Non-albicans Candida species were identified as 58% in urine, blood and vaginal samples of inpatients; *Candida tropicalis* and *Candida glabrata* were the most prevalant non-albicans Candida isolates. In our study a marked increase in the frequency of NAC species has been observed in urine and vaginal cultures in a two year period. Although the reason for this shift towards NAC species is not clearly known, this study emphasizes the importance of constant monitorization of the distribution of Candida species in order to establish appropiate emprical therapy.

Key words - non-albicans Candida, Candida species,vaginal candidasis,candiduria,candidemia

SOME ELEMENTS IN WILD *AGARICUS* AND *AGROCYBE* FROM MARMARA REGION (TURKEY)

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ABSTRACT

Twenty-two element contents were analyzed in five wild *Agaricus* and *Agrocybe* taxa [*Agaricus bresadolanus* Bohus, *Agaricus essettei* Bon, *Agaricus xanthoderma* Genev. *Agrocybe paludosa* (J.E. Lange) Kühner & Romagn. ex Bon and *Agrocybe praecox* (Pers.) Fayod] from Marmara region of Turkey by ICP-AES equipment. The element uptake levels were observed at different levels in each *Agaricus* and *Agrocybe* species. The highest Pb and P concentrations were determined as 16.74 and 1.501 $mg.kg^{-1}$ in *A. essettei* and *A.bresadolanus* respectively. Ag, P and Hg concentrations were determined as 30685, 1,501, and 5978 $mg.kg^{-1}$ in *A. bresadolanus* respectively. *A. essettei* has highest Ni, Cu and Mn concentrations as 37.1, 43.63 and 1476 $mg.kg^{-1}$ respectively, whereas *A. praecox* has highest Mo, Ni and P as 0.54, 10.20 and 27.9 $mg.kg^{-1}$ respectively. *A. paludosa* has highest Zn, Cd and Ba concentration as 336.8, 2.26 and 571.5 $mg.kg^{-1}$ respectively. The highest K concentration were found in *A. xanthoderma* with 5.31 $mg.kg^{-1}$. According to Who and FAO criteria, there is no risk for the metal levels when *Agaricus* and *Agrocybe* would be consumed.

Key words: *Agaricus*, *Agrocybe*, Element, Macrofungi, Turkey

AN EVALUATION ON WHEAT RUST DISEASE IN TURKEY

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ABSTRACT

Wheat is the most widely growing and produced crop in the world and Turkey. In of the wheat growing areas which wheat is planted, biotic stress (diseases) are one of the important factors that limit the production. Among the fungal leaf diseases which are emerged by fungus factor, yellow rust (*Puccinia striiformis* f.sp. *tritici*), leaf rust (*Puccinia triticina*) and stem rust (*Puccinia graminis* f.sp. *tritici*) are the most important diseases. Rust diseases seen in wheat production areas are important and need to focus on the threat. Emerging of the rust diseases and the significance of the of lost yield and quality depends on climate conditions, the extent of appropriate climate conditions for the progress of the rust diseases, virulence of rust diseases factor and reactions of the wheat cultivars. Yellow rust has the potential of causing epidemic throughout in the years which are cool and rainy. Leaf rust becomes effective in Thrace, South Marmara, Central Anatolia – Aegean Transitional zone and Southeastern Transitional zone. Although stem rust has cause to diseases in wheats in coastal area and high-altitude areas depending on climate conditions. The effective, practical and useful one of the methods for farmers' productions is development of the resistant cultivars and the use of these cultivars in production areas.

Key words - Wheat (Triticum sp.), Resistance Cultivars, Rust diseases (Puccinia spp.), Turkey

GLOBAL FOOD SAFETY RISK UG99 STEM RUST RACE

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ABSTRACT

Wheat (Triticium sp.) is one of the most important nutrients for sustainable food safety in the world. Therefore, production is critical. Stem rust (caused by Puccinia graminis f.sp. tritici), a fungal pathogen, is determined in the leaves, stems and spike of wheat. The disease adversely affects grain and straw, yield and quality at different levels. It is also known that yield losses up to 90% may occur in susceptable cultivars under epidemic conditions. In 1999, Ug99 (TTKSK) stem rust race was determined. As a result of the reaction test studies, it was determined that 90% of the wheat genetic materials tested were susceptable to Ug99. It is known that there is a scenario that 19% decrease in wheat production in the world and 1 billion people may be affected due to the epidemic that may be caused by Ug99. Borlaug Global Rust Initiative was established under the leadership of Norman Borlaug with the participation of international research institutions and countries at risk to ensure global food safety. Some of the prominent works carried out by the initiative are as follows. 1) Monitoring the movement of the Ug99 stem rust race. 2) Determination of the reactions of national and international wheat materials under field conditions in Kenya and Ethiopia. 3) Submission of plant protection recommendations to minimize possible damage. 4) Development of human resources through training activities. 5) Organizing workshops for international information. The studies carried out may contribute to the production of solutions by taking the model under the control of similar diseases, especially the diseases spread by wind.

Key words - Wheat (Triticum sp.), Stem rust (*Puccinia graminis* f. sp. *tritici*), variation, food safety

DISEASE CAUSED BY MICROFUNGI ON GOLDEN SESAME GROWING IN MANAVGAT CITY

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ABSTRACT

Sesame (*Sesamum indicum* L.) is a perennial shrub plant belonging to the family Pedaliaceae. Sesame is one of the important oilseed crops in the world, and it grown in countries such as India, Myanmar, Uganda, Nigeria, Pakistan, Bangladesh, Ethiopia, Thailand, Turkey and Mexico. It has economic value among the oil crops cultivated Turkey. Seeds are rich in oil (50-60%), a good source of protein (23-30 g / 100g) and also contains minerals and vitamins. Although sesame is used in the edible oil industry. It is used in the production of tahini and tahini helva and in the production of bakery products such as cookie and bagels. It is also used in cosmetic industry and soap making. This plant grows in warm regions of tropical, subtropical and temperate climate zone of Turkey also the Mediterranean, the Aegean, the Southeast and the Marmara region that it is planted as a second crop after cereals. The provinces producing the most sesame are Antalya, Muğla, Manisa, Mersin, Şanlıurfa and Uşak in our country. It is determined that sesame Muganlı 57 varieties, grown in Manavgat district of Antalya are important in terms of grain size, color and oil content and preferred by the world countries. High yield of sesame seeds and oil yield in Manavgat and its vicinity showed that microclimate conditions of this region are suitable for sesame seeds and the region accelerated sesame cultivation. Manavgat sesame is called 'Golden Sesame'. Golden sesame meets 20 % of total sesame production in Turkey. In this study, the fungi that cause disease on golden sesame were determined. Fungi including Alternaria, Cercospora, Macrophomina, Fusarium, Podosphora-Leveillula species have been found. Fungal descriptions, illustrations and geographic distribution of pathogenic fungi are presented.

Key words - Microfungi, Golden sesame, Manavgat, Turkey

INVESTIGATION OF ANTIFUNGAL ACTIVITY OF YEASTS ISOLATED FROM CITRUS FRUITS AGAINST *PENICILLIUM DIGITATUM* AND *PENICILLIUM ITALICUM*

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ABSTRACT

There are significant losses in the production of fresh fruits and vegetables every year due to fungal plant pathogen. In recent years, many scientific studies have been conducted on the negative effects of chemical fungicides on the environment, the development of resistance in plant pathogen fungi and on the harm to human health. In addition to these studies, interest in the use of antagonist microorganisms and their metabolites has increased as biofungicides. Antagonist yeasts are found in many different areas such as fruit surface, fruit inside and soil. They have an important roles for protection of plants from plant pathogen fungi before harvest. Different yeast species isolated from natural sources are a good option for biological control as they can quickly colonize the fruit surface and enter the food race with harmful molds. The aim of this study was to select yeast to be used as a biological control of fungal growth on citrus. *Penicillium digitatum* and *Penicillium italicum* are molds which has a significant negative effect on citrus products. Different yeasts were isolated from citrus using selective media with antibiotics. Antifungal activities of isolated yeasts were studied in 96-well microplates against *P. digitatum* and *P. italicum*. Morphological identification of yeast was done which has antifungal activity. Yeast which has antifungal activity were stored for use as biofungicides in later pre-harvest studies.

Key words - *Penicillium digitatum, Penicillium italicum*, antagonist yeast, citrus

B GLUCOSIDASE PRODUCTION PURIFICATION AND BIOCHEMICAL PROPERTIES OF *TRICHOTHECIUM ROSEUM* BY THE SOLID STATE FERMENTATION

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ABSTRACT

β-glucosidase, an enzyme with various industrial and biotechnological applications is a hydrolytic enzyme capable of using different glycosidic substrates. In this study, "Solid Substrate Fermentation Technique", which is used as a substrate for rice husks, is aimed to identify the fungal enzyme β-glucosidase activity to be obtained from *Trichothecium roseum* fungus and the β-glucosidase enzyme was purified ammonium sulfate precipitation and sepharose-4B-L-tyrosine-1-naphthylamine hydrophobic interaction chromatography from *Trichothecium roseum*. The β-glucosidase was obtained from the strain of *Trichothecium roseum* by using moistening with Na2HPO4, pH 8.5 rice husks as a medium. For the production of the enzyme, conditions were determined 30°C and 6 days by solid state fermentation. The β-glucosidase enzyme obtained from *Trichothecium roseum* was purified with 21.90 fold, a yield of 27.24%. In the determination of β-glucosidase enzyme activity, p-nitrophenyl-β-D-glucopyranocyte (pNPG) substrate was used and the optimum pH value and optimum temperature values of β-glucosidase enzyme were determined as pH4 and 65 ° C, respectively. The Km and Vmax values of the purified enzyme were determined 0.25 mM and 1250 EU, respectively. Inhibition types of δ-gluconolactone and D(+)glucose were determined competitive type on the β-glucosidase enzyme in the presence of p-nitrophenyl substrate. The IC50 and Ki values of δ-gluconolactone were determined as 6.20 mM and 8.71x10-6 ±1.92x10-7 whereas for the D(+)Glucose 6.22 mM and 2.16x10-4±1.0x10-4 respectively. Microbial β-glucosidases, which are the subject of our work, is using in cosmetic and detergent industries in the synthesis of alkyl and aryl glycosides from ethanol and natural polysaccharides or their derivatives and alcohols derived from cellulosic agricultural residues in the stabilization of fruit juices and beverages, in improving the properties of food and feed products, in biodegradation, in cellulosic agricultural residues. Therefore, ıt is attracting interest. Our findings of the present study will be helpful for cost-effective and optimum production of commercially important enzymes using agro-industrial wastes as growth substrates. Acknowledgments This study was supported with 2018/090-MS Project number by Balikesir University. **Key words**: Trichothecium roseum, β-glycosidase, Solid State Fermentation, Optimization, Purification, Biochemical Properties

Key words - *Trichothecium roseum*, β-glycosidase, Solid State Fermentation, Optimization, Purification, Biochemical Properties

PRODUCTION ISOLATION PURIFICATION AND DETERMINATION OF BIOCHEMICAL CHARACTERISTICS OF B GLUCOSIDASE FROM *TRICHODERMA KONINGII* BY THE SOLID STATE FERMENTATION

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ABSTRACT

Nowadays %90 of enzymes that can be used in every field of industry, is produced by fermentation of microorganisms. Enzymes originating from microorganisms; have higher catalytic activities, do not form an undesired waste product, more stable and cheaper, can be obtained in a higher amount and can be produced in higher purity comparing to enzymes obtained from vegetable and animal sources. In this study aims to obtain a β-glucosidase enzyme from *Trichoderma koningii* NRRL 54330 in optimum conditions using agricultural by-product corncob as a substrate. The enzyme was purified by using two-step procedures, namely ammonium sulfate precipitation and sepharose-4B-L-tyrosine-1-naphthylamine hydrophobic interaction chromatography and then the biochemical and kinetic properties were investigated. β-glucosidase was obtained from the strain of *Trichoderma koningii* NRRL 54330 by using moistening with Na2HPO4, pH 9 corncob as a medium. For the production of the enzyme, conditions were determined 35°C and 6 days by solid-state fermentation. The purification rate of our method was found at 22.56 fold with a yield of 73.51 %. Optimum β-Glycosidase activity as a function of pH and temperature were determined 3 and 75°C using p-NPG (p-nitrophenyl-β-D-glucopyranoside) as substrate. The Km and Vmax values of the purified enzyme were determined 0.16 mM and 2000 EU, respectively. The enzyme was mixed type inhibited by D(+)Glucose and δ-gluconolactone against p-NPG as substrate. The IC50 and Ki values of D(+)Glucose were determined as 4.6975 mM and 4.75x10-3 ±2.37x10-3 whereas for the δ-gluconolactone 3.3982 mM and 1.08x10-6 ±4.89x10-7, respectively. β-glucosidases that originated from microorganisms are mainly used in cosmetic, textile, detergent, animal feeds, tobacco and food industry, the natural polymer modifications, organic chemosynthesis and paper industry, juice and beverage industrial fields. This study has an important role in obtaining an enzyme and its purification and also a determination of new enzyme sources. Moreover, it will have a positive effect on the environment and a great contribution to science and the economy. Acknowledgements The financial support of the Research Funds of Balikesir University (Project no: 2018/089) is gratefully acknowledged.

Key words - *Trichoderma koningii* NRRL 54330, β-glycosidase, Solid State Fermentation, Optimization, Purificat Biochemical Properties

SPECIES BELONGING TO CLADONIA CHLOROPHAEA GROUP DISTRIBUTED IN TURKEY

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ABSTRACT

Cladonia which is widely distributed on all continents and includes more than 400 species worldwide is one of the most common genus of lichens. Cladonia genus is divided into different groups studied by many researchers in terms of phylogeny. *Cladonia chlorophaea* group inculudes eleven Cladonia species; *C. fimbriata, C. chlorophaea, C. humilis, C. conista, C. pocillum, C. hammeri, C. pulvinella, C. dimorpha, C. pyxidata, C. magyarica and C. momomorpha*. Samples were collected during field studies from different regions and ecological characteristics were noted. The collected samples were examined morphologically and anatomically under stereomicroscope. The characters that are important in the systematics of genus; the anatomy and morphology of the primary and secondary tallus, surface anatomy, branching and morphology of the podetia, vegetative propagules, conidium properties and secondary metabolites. Morphological, anatomical and ecological features of 11 Cladonia species collected from various regions of Turkey have been identified. The distinctive characteristics of the species were determined. It has been compared with the samples outside our country.

Key words - Lichen, *Cladonia chlorophaea*, Biodiversity, Systematic

MATING GENOTYPES AND SUSCEPTIBILITY PROFILES OF CLINICAL ISOLATES OF *CANDIDA GLABRATA* FROM TURKEY

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ABSTRACT

The sexual cycle of *Candida glabrata* is not known; however, genomic evidence is indicative of recombination among subpopulations and the genome harbors genes necessary for undergoing mating and meiosis, which may increase fitness. The relationship between specific mating type-like (MTL) loci and antifungal susceptibility is not well understood in *C. glabrata* Objectives: We investigated different combinations of clinical *C. glabrata* isolate mating types and their antifungal susceptibility profiles. Allele profiles of the mating genes of 103 clinical *C. glabrata* isolates were identified and their antifungal susceptibility to azoles, echinocandins, and amphotericin B was compared. The majority (88.3%) of screened isolates harboured the a allele in the locus. The MTL1, MTL2, and MTL3 loci harbored a (88.3%), a (95.1%), and α (71.8%) alleles, respectively. The C. glabrata isolates were susceptible to echinocandins but displayed high minimal inhibitory concentrations (MICs) for azoles. The MIC ranges and MIC90 values of all isolates were 1.0–≥64 and 8.0 μg mL-1 for fluconazole, 0.06–≥16.0 and 0.5 μg mL-1 for voriconazole, 0.06–≥16.0 and 1.0 μg mL-1 for posaconazole, ≤0.015–0.06, and 0.03 μg mL-1 for caspofungin, ≤0.015–0.06 and 0.015 μg mL-1 for anidulafungin, and 0.5–2 and 2.0 μg mL-1 for amphotericin B, respectively. The mating gene alleles of the clinical *C. glabrata* isolates were not associated with differences in the MICs of the tested antifungals, except for the MTL3 α-allele and echinocandins. The mating genotypes of the clinical *C. glabrata* isolates had no recognizable common effect on antifungal susceptibility.

Key words - Antifungal susceptibility, *Candida glabrata*, echinocandins, hospitalization, mating, mycoses, MTL locus, Turkey

Acknowledgements: This study was funded by the Research Fund of Mersin University (Project no.2018-2-AP-2952).

TRICHOLOMA ANATOLICUM VE *TRICHOLOMA CALIGATUM* UN MORFOLOJIK VE MOLEKULER YONDEN KARSILASTIRILMASI

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ABSTRACT

Mantarlar, eski çağlardan beri insanoğlunun ilgisini çeken eşsiz canlılardır. İnsan sağlığı açısından faydalı bir gıda maddesi olmasının yanında, tıbbi açıdan kullanımı da gün geçtikçe artmaktadır. Yenilebilen bazı Tricholoma türleri oldukça lezzetli ve besinsel açıdan zengin olmasından dolayı, doğal olarak toplanmakta ve ticareti yapılmaktadır. Çiçeksi bir kokuya ve tada sahip olan *Tricholoma caligatum* (Viv.) Ricken tüketilen önemli mantarlar türlerinden biri olup, ülkemizde Ege ve Akdeniz bölgelerinde yetişmektedir. Lezzetli ve kaliteli bir besin maddesi olarak dikkat çeken, endemik *Tricholoma anatolicum* H.H. Dogan & Intini ülkemizde Akdeniz bölgesinde yayılış gösteren, halk tarafından toplanıp yenilen, hatta ticareti yapılan önemli bir mantardır. Tricholoma cinsi morfolojik karakterler bakımından diğer cinslerden kolaylıkla ayırt edilebilmesine karşın, yakın morfolojik karakterler bakımından tür düzeyinde tayini oldukça zor bir cinstir. Bu çalışma ile ekonomik değere sahip ve birbirleriyle oldukça benzer *T. caligatum* ve *T. anatolicum* türleri arasındaki akrabalık ilişkileri morfolojik ve moleküler açıdan ele alınmıştır. Genetik ilişkiler ISSR markırları yardımıyla değerlendirilmiştir. Elde edilen dendograma göre *T. caligatum* ve *T. anatolicum* türlerinin birbirlerine % 51 oranında benzerlik gösterdiği tespit edilmiştir. Sonuç olarak, bu iki türü birbirinden kolayca ayırt etmek için burada morfolojik özellikler ve moleküler belirteçler önerilmiştir.

Key words - ISSR, Morfoloji, Tricholoma, Türkiye

CYTOTOXIC EFFECTS OF WILD AND CULTIVATED *PLEUROTUS OSTREATUS* EXTRACTS

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ABSTRACT

Mushrooms have been used for food and medicinal properties since ancient times. Edible mushrooms are a precious source of active compounds. In particular, fungi with therapeutic effect are of interest in many research groups. The medical use of fungal extracts or active compounds appears to be a more natural, less expensive approach and generally has fewer side effects. Furthermore, active compounds derived from fungi may be a potentially valuable source of novel anticancer agents. This study aims to reveal the possible cytotoxic effects of wild and cultivated *Pleurotus ostreatus* (Jacq.) P. Kumm. methanolic extracts upon the DLD-1 cell line. For this purpose, after the fungus samples were dried without sunlight, extracts were prepared using methanol. Prepared extracts were applied in the dose range of 0.3125-5 mg/ml and in two different time intervals. The cytotoxic effects of extracts were evaluated via MTT assay. As a result of the MTT test, the cell mortality rate was found by proportioning the applied extract groups to the control (untreated) group. The results of this study indicate that the obtained extracts show a cytotoxic effect on a dose and time-dependent manner. In conclusion, this study suggests that *P. ostreatus* has a potential therapeutic effect on colorectal cancer and compatible with the other studies of different types of cancer and cell lines. This study is a pioneering study for future studies that will continue to identify active phytochemicals in the extract and find the cause of cell death.

Key words - Anti-proliferative, MTT, Oyster mushroom, Turkey.

MORPHOLOGICAL AND MOLECULAR IDENTIFICATION OF THERMOTOLERANT FUNGI ISOLATED FROM THE THERMOPHILIC ENVIRONMENTS IN AYDIN

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ABSTRACT

It is now well recognized that microbial life can exist at elevated temperatures where most other life-forms fail to survive. Fungi are the microorganisms that have been adapted to extreme environmental conditions. Thermophilic environments have received little attention for the isolation and characterization of thermophilic and thermotolerant fungi. The objective of this study is to introduce thermotolerant fungi species isolated from soil samples the thermophilic environments in Aydın. For the isolation of thermotolerant fungi, soil and water samples of the localities Buharkent, Germencik, Salavatlı, Kuyucak and Imamköy in Aydin province were used as material. Dilution plate technique was used fungi isolation. The samples were cultured in the appropriate dilutions on Rose Bengal Chloramphenicol Agar. Isolated fungi were inoculated on Potato Dextrose Agar and then stock cultures were prepared. The isolated fungi were inoculated on Potato Dextrose Agar medium. The plates were incubated for 4-7 days at 30 oC 40 oC, 45 oC, 50 oC, 55 oC and 60 oC to see the temperature required for the best growth of the isolated microorganisms. The fungus that cannot grow on Potato Dextrose Agar cultured in modified Emerson's (YpSs) medium at the same temperature intervals. Soil analysis at sampling sites was performed by taking into consideration the organic-inorganic matter and moisture content of the soil affecting the development of fungi. Firstly morphological identification of the species was made and then a molecular identification of the species was made. ITS gene regions were used for PCR. Gene sequences were obtained. Sequence analysis of microfungi was performed using BIOEDIT program. After the sequence analysis, obtained sequence data were compared with the data in GENBANK and the molecular identification of the species was made. The MEGA program was used and analyzed to investigate the degree of affinity of the species identified. MEGA was also used to obtain genetic similarity of fungi to each other. Organisms showing best growth at 40 or 50°C were classified as thermotolerant and thermophilic, respectively. None of them showing growth at 20°C. Thermophilic and thermotolerant 91 fungus species belonging to Aspergillus, Penicillium, Mucor, Rhizopus, Trichoderma, Fusarium, Westerdykella, Talaromyces, Lichtheimia, Sarcopodium, Scedosporium and Curvularia were determined by morphologically and molecularly. Incidence (%) of thermotolerant fungi in soils and water samples; Aspergillus 53%, Penicillium 5.5%,, Mucor % 7.7, Rhizopus %9.9, Trichoderma % 5.5, Fusarium %5.5, Westerdykella%2.2, Talaromyces%2.2, Lichtheimia%1, Sarcopodium%1, Scedosporium % 2.2 and Curvularia%1. Many other fungal species could be present in the geothermal soils investigated, but they were not detected by traditional culturing Further studies performed with molecular biology-based techniques, such as polymerase chain reaction (PCR), followed by denaturing gradient gel electrophoresis.

We would like to thank Aydın Adnan Menderes University Scientific Research Unit (BAP Project No: ADU-FEF-15011) for this study.

Key words - Thermophilic, thermotolerant, fungi, ITS, thermal water resource

DETERMINATION OF GENETIC DIVERSITY BY CLASSIFICATION OF VEGETATIVE COMPATIBILITY GROUPS OF TOMATO PATHOGEN FUSARIUM OXYSPORUM IN AEGEAN REGION

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ABSTRACT

Tomatoes (*Lycopersicon esculentum*) are one of the widely grown vegetables worldwide. *Fusarium oxysporum* is a pathogen of plants which causes vascular wilt. The phytopathogenic strains cause destructive vascular wilt disease and often limit the production. However, isolates in the same vegetative compatibility group (VCG) are more genetically similar than vegetatively incompatible ones. Therefore, VCG tests are useful to determine genetic diversities or similarities. Sixty samples were taken from twenty different regions. Later, samples were phenotypically identified as Fusarium sp. according to microscopic observations and media characteristics. After identification, nitrate non-utilizing (nit) mutants were determined. Then, they were divided into four phenotypic mutant classes. After that, vegetative compatibility tests are performed. In our study, six nit1 mutants, six nitM mutants and, five nit3 mutants are found for every district. Sixty-six crossing show that twenty-seven pair of samples are determined as same VCG, thirty-nine couple of samples is defined as different VCG. According to these results, minimum genetic variants have been found between samples. Our study could help to understand the linkages between parasexual recombination and pathogenicity. This study financially supported by Ege University scientific research projects coordination foundation.

Key words - *Fusarium oxysporum*, Vegetative compatibility, Fungus,Tomatoes,VCG

ANALYSIS OF HEAVY METAL POLLUTION IN LICHENS AROUND SEYDİŞEHİR ALUMINIUM FACTORY KONYA

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ABSTRACT

In this study, heavy metal accumulations of lichens growing around the Aluminium Factory in Seydişehir district were investigated. Lichens were determined around the region and heavy metals (Mg, Al, Cr, Fe, Co, Ni, Cu, Zn, Cd, Pb) were analyzed by ICP-MS. 20 samples from 9 different biomonitor species from 6 different localities were investigated in the field studies between 2016-2018. According to the obtained results, Fe, Mg and Al quantities around Seydişehir Aluminium Factory were found in much greater amounts than the other heavy metals examined. Lichen samples have generally been found to have an absorption according to the heavy metal density in the air. According to the obtained data, the first three lichen species with the highest heavy metal content in totally, Phaeophyscia nigricans (23.856.811 ppb) was collected from Taşağıl Region, *Cladonia pyxidata* (12.910.112 ppb) collected from the Susuz region and *Cladonia pyxidata* collected from the Taşağıl Region. (12.487.862 ppb). Three lichen species with the least heavy metal content in totallly were *Evernia prunastri* (1.917.779 ppb) was collected from the Madenli Region, *Pseudevernia furfuracea* (2.686.822 ppb) collected from the Madenli, *Pseudevernia furfuracea* (3150077 ppb) collected from the Kuğulu Park. No lichen species were found around the Factory. The use of lichens as biomonitor was determined with this study for the determination of air pollution. It is important that such studies are repeated at regular intervals in order to be meaningful.

Key words - Heavy Metal, Biomonitor, ICP-MS, Lichen, Seydişehir, Konya.

NEW MACROFUNGI RECORD FROM TURKEY WITH MOLECULAR DATA *XEROCOMELLUS REDEUILHII*

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ABSTRACT

In this study, *Xerocomellus redeuilhii* A.F.S. Taylor, U. Eberh., Simonini, Gelardi & Vizzini collected from Osmaniye (East Mediterranean region, under Arbutus unedo) has been recorded first time in Turkey. Total genomic DNA was isolated from dried samples and ITS rDNA region was amplified in PCR by using ITS1F-ITS4 primers. The sequences obtained and edited were compared with the samples in Genbank database and confirmed as *X. redeuilhii*. This species, found usually in the Mediterranean part of Europe, was identified first time from Asia with this study presented. The results obtained expand significantly the geographic range of the species to the east.

Key words - Xerocomellus, new record,Turkey

NEW GENUS RECORD FOR TURKEY MYCOBIOTA *HYPOCOPRA EQUORUM*

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ABSTRACT

To contribute to mycobiota of Turkey was aimed in this study. The dung samples were collected during periodic mycological excursion from the Aksaray Province in June 2015. They were transferred to the laboratory and microscopic investigations were carried out. The collections were examined in distilled water and for morphological photographs Olympus SZX16 with Olympus DP digi-CAM (Japan) stereo microscope, and microphotographs Laica DMLB with Leica DFC320 digi-Cam (Germany) research microscope were used. The specimen was identified with the help of Bell (2005). As a result: *Hypocopra equorum* (Fuckel) G. Winter was identified on Horse dung. Hypocopra was recorded first time in genus level for Turkey mycobiota. Morphological and microscopic characteristics of the record were presented depend on collected samples, and supported by macro and microphotographs.

Key words - Biodiversity, New record, Hypocopra, Horse dung

MYXOMYCETES BIODIVERSITY AND ECOLOGY IN KÖROĞLU BELİ FOREST AFYONKARAHİSAR

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ABSTRACT

The Myxomycetes, or slime moulds, also known as Mycetozoa or Myxogastria, are a group of ameboid protists, considered for many years as a special group of fungi. A study of the biodiversity and ecology of myxomycetes was carried out in Köroğlu Beli Forest, Afyonkarahisar. Samples of aerial bark from dead and living trees, aerial litter (dead but stil attached plant parts), ground litter (fallen dead plant parts) and wood (fragments of dead wood) were collected from study area. For samples, data on a series of microhabitat parameters (substratum type, pH, the stage of decomposition, the extent of contact of the substratum with the ground, substratum moisture) were recorded. Myxomycetes were cultured from collected samples using the moist chamber technique. Species diversity (alpha-diversity) was calculated using Shannon's diversity index H' = –∑Pi log Pi, Canonical CCA analysis was used to analyze the relationship between the relative abundance of myxomycetes species and environmental variables. A total of 137 records belonging to 49 species 15 genera was collected from the 151 moist chamber cultures. *Licea minima* as the most common species was recorded 15 times, but 33 species of all species was classified as ocasionally for the study area. Among three different groups of substrata (bark of shrubs, ground litter, ariel litter and wood) diverging trends in species richnesss were found: bark had the richest (H'=3.00), ariel litter (H'=2,14) the poorest. Correspondence Analysis (CCA) showed that species distribution patterns were closely related to: (1) ph value; (2) the extent of contact of the substratum with the ground; and (3) the different types of subsratum. It was observed that species distribution was affected by environmental factors.

Key words - myxomycetes, biodiversity, ecology, CCA

DETERMINATION OF YEAST FLORA IN CHEESE MADE FROM BUFFALO MILK

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ABSTRACT

Yeasts can be isolated from many varieties of cheese as natural contaminants. The positive effects of yeasts on cheese quality have been reported especially in recent studies. Some yeast is known to contribute to the formation of the typical flavor and structure of cheeses. Some probiotic yeast species have also been reported to cause inhibition of pathogenic microorganisms that cause spoilage in cheeses. The studies concerning the use of yeasts as adjunct starters together with lactic acid bacteria in cheese production are increasing. For this reason, it is important to identify yeasts isolated from cheeses and to carry out the necessary tests for their use as adjunct cultures. In addition, new probiotic yeast isolates can be obtained from artisanal cheese. In Turkey, there is no study about yeast mycobiota of cheese produced from buffalo milk. In this study 20 cheese samples produced from buffalo milk obtained from different provinces of Turkey (7 Mozzarella cheese samples and 13 white cheese samples) were analyzed for yeast load. 180 isolates were selected by grouping similarities in terms of morphological, physiological and some biochemical properties from 406 isolates obtained. These isolates were identified by both phenotypic and MALDI-TOF MS method. The identified dominant yeast genera were found as; Debaryomyces (41.51%), Candida (23.27%), Clavispora (7.55%), Pichia (6.92%) and Kluyveromyces (6.29%). Some species of Debaromyces and Candida are well known as a contaminant of other cheeses. However, some species are also reported to have probiotic properties. Therefore the probiotic potential of these isolated yeasts should be investigated

Key words - yeast flora,Maldi-TOF MS, Cheese,buffalo milk

MICROFUNGI OF NEZAHAT GOKYIGIT BOTANIC GARDEN I NEW FAMILY AND SPECIES RECORDS BARTALINIACEAE AND *AMEROSPORIUM POLYNEMATIODES*

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ABSTRACT

To contribute to mycobiota of Turkey was aimed in this study. The microfungi samples were collected during periodic mycological excursion from the Nezahat Gökyiğit Botanic Garden (NGBB) in June 2018. They were transferred to the laboratory and microscopic investigations were carried out. The collections were examined in distilled water and for morphological photographs Olympus SZX16 with Olympus DP digi-CAM (Japan) stereo microscope, and microphotographs Laica DMLB with Leica DFC320 digi-Cam (Germany) research microscope were used. The specimens were identified with the help of Nag Raj (1993), Crous et al. (2014) and Sutton (1980, repr. 2004). As results: *Bartalinia robillardoides* Tassi (Bartaliniaceae) was identified on leaves of *Phyllostachys glauca* Mc Clure, and *Amerosporium polynematoides* Speg. was identified on leaves of *Phyllostachys aureosulcata* Mc Clure. *B. robillardoides* was recorded as family level, and *A. polynematoides* was recorded as species first time for Turkey mycobiota. Morphological and microscopic characteristics of the records were presented depend on collected samples, and supported by macro and microphotographs. The Authors would like to thanks the Ali Nihat Gökyiğit (ANG) Foundation for support.

Key words - Biodiversity, New record, Bartaliniaceae, Amerosporium, Phyllostachys

FUNGAL DETERIORATION OF STONE MONUMENTS

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ABSTRACT

Cultural heritages are at risk of biodeterioration caused by diverse populations of microorganisms such as fungi, bacteria, algae, lichens and cyanobacteria. For example, stone monuments may be discolored and degraded by growth and activity of microorganisms. Especially fungal communities cause aesthetic and structural damage. The fungal deterioration of stone monuments in many countries has become a serious threat for their existence. A review of work on fungal deteriorations on stone monuments, including recent studies resulting from molecular biology, is presented and fungal species causing degradation are discussed.

Key words: Stone, Monuments, Fungi, Deterioration

OTOMYCOSIS IN A SUBTROPICAL REGION THE ROLE OF WHICH OF THE FUNGAL AGENTS IS PREDOMINANT

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ABSTRACT

Introduction: Otomycosis is often used to describe external ear infections including those related to the auricle, eardrum, auditory canal, and middle ear. Fungal agents include the wide range of mold fungi saprophytes, saprophytic yeast with endogenous origin, yeast-like factors, and dermatophytes with exogenous origin. With increasing opportunist infections, different fungal species with variable sensitivity to anti-fungal drugs and due to the lack of precise pattern for inner ear infection with fungal agents, this study seems to be crucial in the Mideast, the north east of Iran.

Material and method: Getting suspicious about the external ear fungal-dependent infection, according to the clinical symptoms of externa and media ear, sample of 140 patients were collected. Sampling performed from the external ear with the specific speculum and by aspiration from the existing mass in the auditory canal, pus and possible mucus. Then, samples were transferred into sterile microtubes and gathered at the mycology and pathology laboratories. In specific mycology laboratory, direct examination with KOH, cultivation with sabouraud dextrose agar with chloramphenicol, DNA extraction from fungal colonies, PCR and sequencing of PCR products and analyzing with Seqman and Chromas have been performed and BLAST in worldwide gene bank.

Results: In this study, totally out of 140 patients 46 were infected with otomycosis (32%) that out of 90 patients with external ear infection, 40 (44.4%) and out of 50 cases of media ear infection, 6 (12%) were fungal infections. The most common infectious fungi detected were *Aspergillus flavus* in 11 (24%) and *A. niger* in 10 (22%), *Candida parapsilosis* 8 (18%), A. tubingensis 5 (11%), A. oryza 4 (9%), C. albicans 3 (6%), Purpureocillium 2 (4%), C. allociferrii 1 (2%), Eurotium 1 (2%) and *Magnusiomyces capitatus* 1 (2%). Most common clinical manifests were itch and otorhea. Conclusion: Aspergillus is the main filamentous fungal for causing otomycosis. The most common species are *A. flavus* and *A. niger*, respectively. Candida species also can cause otomycosis which *C. parapsilosis* and *C. albicans* are the most common.

Key words - Otomycosis, Candida, Mashhad,Aspergillus,Externa and media ear,Infection,Subtropical Region

FUSARIUM PSEUDENSIFORME'YE BAGLI İLK MIX ONIKOMIKOZ OLGUSU

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ABSTRACT

Onikomikoz en sık dermatofitlerin, nadiren diğer etkenlerin sorumlu olduğu tırnakların fungal enfeksiyonudur. Bu yazıda literatürde ilk kez Fusarium pseudensiforme'ye Candida parapsilosis ve Pseudomonas auroginosa'nın eşlik ettiği onikomikoz olgusu sunuldu. OLGU 20 yaşındaki erkek hasta, 2-3 ay önce başlayan tırnakta renk değişikliği ve matlaşma şikâyetleriyle hastanemize başvurdu. Sol el birinci tırnağında yeşilimsi renk değişikliği saptanan olguya Pseudomonas'a bağlı enfeksiyon düşünülerek oral ciprofloxacin 2x750 mg/gün başlandı. Üç ay antibiyoterapiye devam eden olguda tırnaktaki yeşilimsi renk siyahlaşmaya başladığından fungal inceleme yapıldı. Tırnak kazıntı örneğinin %30'luk potasyum hidroksitli direkt preparatında hifler görülmesi üzerine tırnak çekimi planlandı. Hastanın tırnak çekimi gerçekleşmeden önceki alınan ilk kazıntı örneğine % 30'luk Potasyum hidroksitli direkt preparatında mantar hifleri görüldü. Tırnak parçaları ve kazıntı örnekleri Sabouraud dextroz agar ve Cyloheximit ilaveli Sabouraud dextroz agara ekilerek 25˚C ve 35˚C'de inkübe edildi. Yaklaşık üçüncü günde maya mantarı, bakteri, 5. günde saprofit fungus üremesi oldu. Tırnak çekimi yapıldıktan sonra kültürler tekrarlandı. Bir önceki ekimi yapılan kültür ile sonuç benzerdi. Her iki kültür de *Fusarium pseudensiforme, Candida parapsilosis* ve *Pseudomonas auroginosa* üredi. *Candida parapsilosis* ve *Pseudomonas auroginosa*'nn identifikasyonu, klasik yöntem ve VİTEK 2 compact ile yapıldı. *Fusarium pseudensiforme* makroskobik ve mikroskobik özellikleri ile birlikte moleküler yöntemler kullanılarak isimlendirildi. Sangers Sekansı yöntemi ile dizi analizi yapıldı. Elde edilen sekans dizileri ile DNA tabanında flogenetik veri analizi gerçekleştirilerek tür tayini doğrulandı. Sonuç olarak, insanlarda onikomikoz etkeni olarak yeni fungal patojenlerin de rol oynayabileceği, diğer maya ve bakterilerin de enfeksiyona eşlik edebileceği akılda tutulmalıdır.

Key words - *Fusarium pseudensiforme, Pseudomonas auroginosa, Candida parapsilosis,* onikomikoz

SYNTHESIS OF SILVER NANOPARTICLES BY *ASPERGILLUS CLAVATUS* ISOLATED FROM HYPERSALINE ENVIRONMENTS AND THEIR BIOACTIVITY

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ABSTRACT

Nowadays, the most important approach for the development of reliable and environmentally friendly processes for the synthesis of nanomaterials is the use of biological materials, also called green synthesis. For studies on the green synthesis of nanoparticles, the focus has been on plants-plant extracts, fungi and bacteria. Fungi are characterized by their eukaryotic cell structure, easy production under laboratory conditions, etc. In this study, green synthesis of silver nanoparticles using by *Aspergillus clavatus* isolated from hypersalin environment were determined and their biological activities were determined. For the characterization of AgNP produced by *Aspergillus clavatus*, peaks of 400-450 nonometers were checked using the Uv-Vis spectrophotometer, then the size and percentage distributions of the nanoparticle produced using the dynamic light scattering spectrophotometer (DLS) were measured. The transmission electron microscope was used to view AgNP, it appears that the nanoparticles are produced in different sizes. As a result of all characterization analyzes, the nanoparticles produced have a -12.4 ± 0.2 mV surface load spherical, 28-48 nm diameter. EC50 value was determined as 125.000 mg.L-1 by Vibrio fisheri toxicity test. The effect of AgNP produced on seed of *Lactuca sativa* germination was examined and 80 mg.L-1 gave the best root elongation while 40 mg.L-1 gave the best shoot elongation. DPPH scavenging effect for antioxidant activity was measured as 30.46 % ± 0.51%. The antimicrobial activity of the synthesized AgNPs against 5 different bacteria was determined by agar well method and MIC values ranging between 6.250-12.500 µg .ml-1 were found. In light of all these, production of silver nanoparticles with high industrial demanded is done with green synthesis and it is very important to determine the bioactivitic limits of nanoparticles formed as a result of this synthesis. In this way, in this period in which environmentally friendly production is at the forefront, these studies become very important.

Key words - Silver Nanoparticle, Fungi, Hypersaline Environment, Green Synthesis, Bioactivity

MİKROFUNGUSLAR BİR MERKEZİ LABORATUVAR DENEYİMİ HANGİ ÖRNEK HANGİ MAYA

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ABSTRACT

Doğada yaygın olarak bulunan mantarların tanımlanmış 100000'e yakın türü olduğu tahmin edilmekle beraber bunlar arasından yaklaşık 100-150 tür insanlarda enfeksiyon etkeni olarak saptanmaktadır. Ancak günümüzde bağışıklık sisteminin zayıfladığı hasta sayısının artışına paralel olarak patojen türlerin sayısı her geçen gün artmaktadır. Mantarlar insanlarda normal floranın bir üyesi olmanın yanısıra yoğun bakım ünitesi'nde yatma, hematoonkolojik malignite, diyabetes mellitus, büyük cerrahi girişimler ve immünsüpresyon gibi kolaylaştırıcı faktörlerin varlığında deri, deri altı doku ve mukozaların tutulduğu lokal enfeksiyonlardan, fetal sistemik enfeksiyonlara kadar değişebilen çeşitli hastalıklar oluşturabilirler. Bu çalışmada çeşitli klinik örneklerden izole edilen mayalar retrospektif olarak incelenmiştir.

Ocak 2015 ve Aralık 2018 tarihleri arasında İstanbul İl sağlık Müdürlüğü, Kamu Hastane Hizmetleri Başkanlığı-2, Merkezi Laboratuvara hizmet bölgesindeki hastanelerden gönderilen çeşitli klinik örneklerde üreyen mayalar retrospektif olarak incelendi. Tanımlama MALDI-TOF MS [VITEC®MS (Biomerioux, France)] ve konvansiyonel yöntemler (makroskobik ve mikroskobik koloni morfolojisi, germ tüp testi, kromojenik agar görünümü, mısır unu-tween 80 besiyerindeki görünümü, üreaz testi pozitifliği) ile yapıldı.

Maya üremesi saptanan toplam 6423 klinik örneğin dağılımı incelendiğinde; 3739 idrar (% 58), 1011 kan (% 15,8), 347 yara (% 5,4), 346 vajen serviks (% 5,4), 297 endo trakeal aspirat (% 4,7), 236 kateter (% 3,7), 232 balgam (% 3,7), 63 doku (% 1), 33 bal (% 0,5), 32 periton sıvısı (% 0,4), 25 plevra sıvısı (% 0,4), 19 safra sıvısı (% 0,3), 11 bos (% 0,2) ve 32 diğer (abse, konjunktiva, kulak ve boğaz sürüntüsü, kalp kapağı, mediasten, cilt) örnekler (% 0,5) olarak değerlendirildi. Bu klinik örneklerden izole edilen mayaların cins ve tür dağılımları incelendiğinde ise; toplam 6423 mayanın, 6257 (%97,4)'si Candida cinsi olarak saptanırken tür düzeyinde en sık *C. albicans* 3243 (%51,82) bunu takiben sırası ile *C. glabrata* 824 (%13,16), *C. tropicalis* 818 (%13,07), *C. parapsilosis* 624 (%9,97), *C. kefyr* 404 (%6,45) ve *C. krusei* 160 (%2,55) olarak saptandı. Geriye kalan %2,6'lık kısmını oluşturan diğer mayalar ise *C. lusitaniae, C. dubliniensis, C. inconspicua, C. famata, C. guilliermondii, C. lipolytica, C. pelliculosa, C. utilis, C. norvegensis, Trichosporon asahii, Cryptococcus neoformans, Saprochaete capitata* ve *Saccharomyces cerevisiae* olarak belirlendi. Maya üremesinin en sık saptandığı örnekler idrar (% 58) ve kan (% 15,8) örnekleridir. İdrar'dan en sık izole edilen mayalar sırasıyla *C. albicans* (% 47,9), *C. glabrata* (%15,4), *C. tropicalis* (%14,2), *C. kefyr* (%8,5), *C. parapsilosis* (%4,9) olup, Candida dışı mayalar içinde de en sık *Trichosporon asahii* (%3,9) bulunmuştur. Mortalite ve morbiditenin yüksek olduğu kan örneklerinde ise yine en sık *C. albicans* (% 44,7) saptanırken bunu *C. parapsilosis* (%26,2), *C. tropicalis* (%11,2) ve *C. glabrata* (%10,8) takip etmektedir. Bu grupta da Candida cinsi dışında 3 örnekte *Trichosporon asahii* ve 3 örnekte de *Cryptococcus neoformans* saptanmıştır.

İnvazif fungal enfeksiyonlar (İFE), günümüzde çeşitli kolaylaştırıcı faktörlerin varlığında özellikle hematolojik maligniteli ve yoğun bakım ünitesi'nde yatan hastalarda önemli bir morbidite ve mortalite nedeni haline gelmiştir. Birçok faktöre bağlı olarak yıllar içerisinde bu enfeksiyonlara sebep olan mantarların dağılımı ve görülme sıklığı da değişmektedir. Candida türleri özellikle *C. albicans* en sık etken olarak saptanırken son yıllarda antifungal ilaçlara daha dirençli ve daha ölümcül enfeksiyonlara sebep olan *C. glabrata* ve *C. krusei* gibi türlerin yanısıra *C. tropicalis* ve *C. parapsilosis*'in artışı da dikkat çekmektedir. Yine bu hasta grubunda Candida türleri dışında *Trichosporon asahii, Cryptococcus neoformans, Saprochaete capitata* ve *Saccharomyces cerevisiae* gibi diğer mayaların izolasyonunda da artış saptanmaktadır. Bu nedenle enfeksiyon etkenlerinin hızlı bir şekilde tanımlanması ve hedefe yönelik antifungal tedaviye erken dönemde başlanılması morbidite ve mortalitenin azaltılmasına önemli katkı sağlayacaktır.

Key words - Klinik örnekler, maya

DERMATOPHYTES IN PATIENTS ATTENDING TO SELCUK UNIVERSITY HOSPITALS IN KONYA TURKEY

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ABSTRACT

Dermatophytes are keratinophilic molds that hold keratinised tissues such as skin, nails and hair. Detection of dermatophytosis agents is important for prevention and treatment as well as for epidemiological studies. In this study, it was aimed to determine the frequency of isolated dermatophytes by examining samples taken from patients with suspected dermotophytosis and to evaluate the compatibility of clinical diagnoses with laboratory diagnoses.

Hair, skin and nail samples taken from patients with suspected dermatophytosis who attended to Selçuk University Hospital Medical Microbiology Laboratory between 1 January 2010 and 1 July 2019 were examined. Preparations prepared with 10% KOH were subjected to direct microscopic examination. Sabouraud Dextrose Agar was used for the cultivation of samples with culture demand. The colonies in the plates were examined macroscopically and microscopically. In macroscopic examination; colony growth rate, surface appearance, surface color and base color were evaluated. Preparations which were taken from the colonies stained with lactophenol cotton blue were examined microscopically.

1800 (36%) of the 4993 specimens which were examined directly under microscope were found to be positive. Dermatophyte was isolated from 132 (34.1%) of the 387 culture samples. *Trichophyton rubrum* (78%) was the most commonly isolated dermatophytic agent and it was followed by *T. tonsurans* (7.6%), *T. mentagrophytes* (3.8%), *T. verrucosum* (3.8%), *Microsporum canis* (3%) and *Microsporum gypseum* (2.3%). Of the 1800 samples 905 (50.3%) were positive by microscopy and were diagnosed as dermatophytosis by clinicians. The diagnosis of dermatophytosis were 41.9% Tinea unguium, 21.7% Tinea pedis, 20.5% Tinea corporis, 7.3% Tinea manuum, 5.1% Tinea cruris, 3.6% Tinea barbae and Tinea capitis. Although 11.3% of the patients were prediagnosed as clinical dermatitis, fungal elements were observed on direct microscopy.

Dermatophytes are one of the most common causes of superficial fungal infections and are also common in our country. The incidence of dermatophytes varies according to age, gender, geographical and climatic conditions. In our study, fungal elements were observed in 36% of the patients who were evaluated by direct microscopy. As in our study, the most common dermatophyte causative agent isolated in culture in our country is T. rubrum. According to the results of our study; agreement between direct microscopy results and clinical diagnosis were 50.3%; however, it was 63.6% between culture results and clinical diagnosis. In line with this data; In addition to clinical evaluation for the diagnosis of dermatophytosis, direct microscopic examination and culture will be useful.

Key words - culture, dermatophytes, diagnosis, direct microscopy

DETERMINATION YEAST LOAD AND IDENTIFICATION OF CANDIDA SPP ISOLATED FROM MOUTH

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ABSTRACT

About of bacterial microbiota in the human body are a lot of studies, but fungal microbiota (mycobiota) studies are a little behind the bacterial microbiota studies. However studies of fungal microbiota are rapidly developing area recently. Each human carries fungi in microbiota, but the bacteria are more than the fungi in human microbiota. Moreover human microbiome is important because it has effects on our health. However, in some cases, degradation of the microbiota leads to the increase of particularly opportunistic pathogenic microorganisms. These opportunistic microorganisms are generally fungi, especially Candida spp. yeasts. By this research, the yeast load in the mouths of healthy young participants was determined and the obtained yeast isolates were identified. Samples were collected by mouth washing for 1 min using 10 mL sterile phosphate buffer (PBS). Samples were centrifuged at 4000 rpm for 20 min. After centrifugation, the supernatant was discarded and 400 µL of PBS was added to the pellet and were vortexed. For each sample, 100 µL of samples were cultured in duplicates on Sabouraud Dextrose Agar (SDCA) containing chloramphenicol and Sabouraud Dextrose Agar (SDA) medium. Plates were incubated at 37 ° C for 48 hours. After incubation, the yeast load of the samples was determined. Then, isolates were taken plates for identified of yeasts. The yeast isolates were identified by lactophenol blue stain and by germ tube test. A total of 31 participants were sampled. The yeast loads in SDCA medium was determined ranging from 0.01±0.01 and 1.87±0.01 log cfu in 12 participants. Also, the yeast load in SDA medium was determined > 3.00±0.01 log cfu in 29 participants. A total of 342 isolates were taken, but isolates of 134 were determined to be yeasts with lactophenol blue staining. For yeast isolates performed germ tube test in human serum and determined *C. albicans* in participants. It was determined that *C. albicans* was found in the mouth mycobiota of healthy young individuals between 18-25 years.

Key words - *C. albicans*, mycobiota, yeast, mouth

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STATISTICAL OPTIMIZATION OF OCHRATOXIN A DEGRADATION BY *AGARICUS CAMPESTRIS*

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ABSTRACT

Ochratoxin A is known as the second important and common mycotoxin after aflatoxin. It has nephrotoxic, teratogenic, genotoxic and carcinogenic effects on all living things. In the present study, statistical methods were performed for optimization of Ochratoxin A degradation by an *Agaricus campestris* strain (OBCC 5048; Eskişehir Osmangazi University, Biology Department, Fungiculture Laboratory, Turkey) which was selected among ninety-four macrofungi isolates. The response surface and Box-Behnken methods were used to optimize the growth condition of Agaricus campestris for degradation of ochratoxin A. To improve ochratoxin A degradation, the best medium components were selected using Plackett-Burman statistical design. To identify the media compositions and conditions, the response surface method (RSM) was applied using the Box–Behnken design. As a result, the highest ochratoxin A degradation rate (56%) was achieved at the optimized conditions of 30 g/L glucose, 5 g/L soytone, 12 days incubation, 28 ºC temperature, initial pH 5, inoculum rate 7,5 % and 125 rpm agitation speed.

Key words - Ochratoxin A, Degradation, Optimization, *Agaricus campestris*

STATISTICAL OPTIMIZATION OF PLANT GROWTH REGULATORS PRODUCTION BY *PLEUROTUS CALYPTRATUS*

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ABSTRACT

Plant growth regulators (PGR) play an indispensable role in agriculture and horticulture. Not only higher plants but also algae, bacteria, and fungi can produce PGR such as gibberellic acid (GA), indole acetic acid (IAA) and absisic acid (AA). In this study, GA, IAA and AA production performance of *Pleurotus calyptratus* Ag461 (Czech Republic) was determined as a first report. As a first step, the best culture system for PGR production by the strain was selected. For that purpose, PRG production by the strain was monitored during incubation under solid-state (SSF), static (SF) and submerged (SmF) culture systems. Then, with the selected culture system, the PGR production by the *Pleurotus calyptratus* Ag461 was optimized with Plackett Burmann statistical design. As a result, SmF favored to the maximum PGR production by the studied fungus species when compared with the other culture types. The GA, IAA, and AA production values by *Pleurotus calyptratus* Ag 461 reached 1479.5, 117.8 ve 9.1 mg/L, respectively, at the 21st day of incubation. After Plackett Burmann methodology, the highest GA, IAA and AA production values (3302.83, 331.65, and 83.82) were achieved at the optimized conditions such as 30 g/L lactose, 3 g/L NH4NO3, 1 g/L MgSO4, 1 g/L KH2PO4, 21 days incubation, 30 ºC temperature, initial pH 4, inoculum rate 7,5 % and 200 rpm agitation speed.

Key words - Absisic acid Gibberellic acid, Indole acetic acid, Optimization, *Pleurotus calyptratus*

MOLECULAR IDENTIFICATION SECONDARY METABOLITE PROFILING AND ANTIMICROBIAL ACTIVITIES OF ENDOPHYTIC FUSARIUM SPECIES

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ABSTRACT

Endophytic fungi are a rich source of natural products and have potential as bioactive drugs, pigments, biotechnological enzymes. Therefore, the detailed investigation of these endophytic fungi using molecular identification and profiling of secondary metabolites such as antibiotics, hormones, pigments, mycotoxins is utmost important. In the present study, Fusarium spp. isolated from orchids (saleps) were firstly identified by molecular identification methods including amplification of the beta-tubulin gene region. Then, the beta-tubulin gene region was sequenced and the endophytic Fusarium isolates were identified as *Fusarium redolens* (n=6) and *Fusarium oxysporum* (n=2). For secondary metabolite profilling of crude fungal extracts using HPLC-DAD, Fusarium species were cultivated as three point inoculation on two different media (Potato Dextrose agar and Yeast Extract Sucrose agar) at 25±2 oC in the dark for 7 d. All agar plugs from each of the cultures were transferred into 20 ml vials for extraction with a mixture of ethyl acetate/dichloromethane/methanol (3:2:1) (v/v/v) including 1% formic acid. Consequently, HPLC-DAD profiling of the extrolites produced by *Fusarium redolens* and *Fusarium oxysporum* were compared. The antimicrobial activity of crude fungal extracts was tested using the disk diffusion method and Fusarium species were evaluated for their potential to have antimicrobial activity against *Staphylococcus aureus* ATCC 6538, *Escherichia coli* ATCC 25922, *Candida albicans* DSM 1665, *Pichia anomala* DSM 6766. Based on the results, the crude extracts of *Fusarium oxysporum* strains were not effective against test bacteria and *Candida albicans* DSM 1665, whereas the crude extracts of three strains belong to *Fusarium redolens* were found more effective against *Candida albicans* DSM 1665 and one of species showed antibacterial activities against the test bacteria. In conclusion, this study has shown that Fusarium redolens strains may be potential for antifungal agent especially against *Candida albicans*. Acknowledgements The author is thankful to the Natural Product Chemistry Laboratory and the Fungal Biotechnology Laboratory of Bioengineering Department, Ege University.

Key words -Endophytic fungi, *Fusarium redolens*, *Fusarium oxysporum*, beta-tubulin gene, antimicrobial activity, *Candida albicans*

DETERMINATION OF FATTY ACID COMPOSITIONS OF *LAETIPORUS SULPHUREUS* (BULL.) MURRILL AND *LYOPHYLLUM DECASTES* (FR.)SINGER BY GC FID

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ABSTRACT

Laetiporus sulphureus (Bull.) Murrill. and *Lyophyllum decastes* (Fr.) Singer species were collected from Bozkır (Konya) district. The collected samples were brought to the laboratory in paper bags and the drying process was performed. The dried fungus samples, which were converted into suitable forms, were extracted for 6 hours with a soxhlet device using hexane and made ready for GC analysis form. Fatty acid compositions were determined by GC-FID analyzer. *L. sulphureus*: Cis-11-Eicosenoic acid (52.8213%), gamma-Linolenic acid (10.3900%), Capric acid (8.2087%); *L. decastes*: gamma-Linolenic acid (42.6720%), Linoleic acid (38.2950%) and Palmitic acid (11.1383%) with the highest percentage of free fatty acid (FFA) values were found to form.

Key words - *Laetiporus sulphureus*, *Lyophyllum decastes*, Extraction, GC-FID, Free Fatty Acid

INVESTIGATION OF BIOFILM FORMING CAPACITY OF CANDIDA SPECIES IN HOSPITAL ACQUIRED URINARY TRACT INFECTIONS

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ABSTRACT

Candida species are one of the most common causes of hospital-acquired urinary tract infections (HA-UTIs). The ability of Candida species to form biofilms on abiotic surfaces enables them to colonize the catheters which can, and often leads to infection in patients with urinary catheters. In our study, we aimed to investigate the biofilm producing ability of Candida species isolated from urine samples of catheterized patients and determine the species distribution. Patients who were hospitalized, had urinary catheters and diagnosed with UTI were included in this study. Urine samples were inoculated on blood agar plate, eosin-methylene blue agar and Saboraud's dextrose agar and incubated at 37 oC. Yeast strains determined as the causative agent were identified to species level by conventional phenotypic methods (germ tube production, growth patterns on cornmeal agar, carbohydrate assimilation and fermentation profiles). Crystal violet assay was used to determine biofilm production. In total 71 Candida strains were isolated from 52 patients. Species distribution was as follows: 24 (33.8%) *C. albicans*, 24 (33.8%) *C. tropicalis*, 17 (23.9%) *C. glabrata*, 2 (2.8%) *C. keyfr*, 2 (2.8%) *C. krusei* and 2 (2.8%) *C. parapsilosis*. Biofilm formation has been detected in 49.2% of Candida strains. The rate of biofilm formation was found to be 58.3% in *C. albicans* strains and 44.6% in non-albicans Candida (NAC) strains. Among NAC species, 11 of 24 (45.8%) *C. tropicalis* strains, 7 of 17 (41.2%) *C. glabrata* strains, both strains of *C. keyfr* (100%) and 1 of the 2 *C. parapsilosis* strains (50%) formed biofilms. Biofilm formation was not observed in both of the *C. krusei* strains. Biofilm formation by Candida species poses a serious threat as it often leads to infection and treatment failure is common since cells embedded in biofilms are less susceptible to antifungal agents. In our study, almost half of the strains isolated from catheterized patients formed biofilms. Inter and intraspecies variation in the ability to produce biofilms detected in this study underlines the importance of identifying the Candida strains to species level and the need to determine biofilm forming strains to establish proper management of HA-UTIs. The need for urinary catheterization should be carefully assessed and catheterized patients should be regularly monitored in terms of infections. In addition, development of new strategies targeting fungal biofilms and antibiofilm coatings are needed to prevent HA-UTIs caused by Candida species.

Key words - *Candida albicans*, non-albicans Candida, biofilm, hospital-acquired urinary tract infections

ANTIFUNGAL AND ANTIBIOFILM ACTIVITIES OF ANTI INFLAMMATORY DRUGS AGAINST CANDIDA STRAINS

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ABSTRACT

Candida species cause several types of infections with high mortality rates in human, and the emergence of resistance to the antifungal agents requires the development of alternative agents against these pathogens. Biofilms are defined as an organized community of microorganisms, and in the biofilm layer microorganisms can be resistant to many antimicrobials. It is known that anti-inflammatory drugs have antimicrobial effects on various microorganisms. The aim of this study was to investigate the antifungal and antibiofilm activities of anti-inflammatory drugs (acetylsalicylic acid, acetaminophen, diclofenac, ibuprofen and naproxen) against *Candida albicans*, *Candida parapsilosis* and *Candida krusei* strains. Antifungal effects of the drugs were investigated by disk diffusion test and microdilution method according to the EUCAST criteria. Biofilm production levels of Candida strains were determined in the presence of the drugs (100 and 1000 µg/ml) by spectrophotometric microplate method using crystal violet staining. All the experiments were performed in triplicate, and the statistical analyses were performed using GraphPad program. According to the results of disk diffusion test, inhibition zones were obtained with acetylsalicylic acid, diclofenac, ibuprofen and naproxen at the studied concentrations. Minimum inhibitory concentrations of the drugs were determined between 1024 and 8192 µg/ml according to the microdilution method results. Anti-inflammatory drugs showed different effects on the biofilm production levels of the strains, and the biofilm production rates varied depending on the drugs and the concentrations. In conclusion, new antifungal agents and alternative treatment strategies are necessary to control the infections caused by Candida strains. We suggest that the drugs that were studied in our experiments have antifungal and antibiofilm activities against Candida strains, and more experimentation will be required about the mechanism of action. The drugs studied and their derivatives may find promise as new antimicrobial agents in the future.

Key words - Antifungal activity, Antibiofilm activity, Anti-inflammatory drugs, Candida strains

INVESTIGATION OF THE EFFECT OF HUMIC SUBSTANCES AND GIBERELLIC ACID IN THE MYCELIUM GROWTH OF *LENTINULA EDODES*

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ABSTRACT

In this study, the effect of humic substances and gibberellic acid (GA3) on mycelial development of *Lentinula edodes* was investigated. Malt extract agar (MEA) and potato dextrose agar (PDA) were used as feedstock in the study and malt extract agar and potato dextrose agar were sterilized by autoclaving at 121°C for 15 min with the addition of specific doses of agaric material. In the Pasteur oven, nutrients were poured into sterile petri dishes in the sterile safety cabinet. After the feedstock sites solidified, the transfer of the media containing the mycelium was carried out in the same cabin. After this process, the petri dishes were taken to the incubation oven. At certain intervals mycelial developments were drawn spatially. As a preliminary study, 0%, 1%, 3%, 5%, 7% and 9% of humic substances and gibberellic acid (GA3) were added to feedstock and according to the results of the applications made at these rates, it has been decided to make the working trials at 0%, 0.5%, 1%, 1.5%. In this study, malt extract agar and potato dextrose agar supplemented with 0%, 0.5%, 1% and 1.5% of humic substance and gibberellic acid (GA3) were added to petri dishes. Mycelium growth amounts and densities of *Lentinula edodes* were investigated.The experiments were done in 3 replicates. According to the analysis of variance with trial results the differences between the means were found to be statistically significant ($P < 0.01$). When %0, 0.5%, 1% and 1.5% of humic and gibberellic acid (GA3) applications were evaluated, no high correlation was found between the amount of growth and additives and only a relatively high improvement was observed in the application of 0.5% and 1.5% humic acid in MEA feedstock ($R^2 = 0.359$).

Key words - *Lentinula edodes*, Humic Substance, gibberellic acid (GA3), Mycelium Development, MEA, PDA

THE EFFECTS OF LACTIC ACID BACTERIA LAB AGAINST MOLDS WHICH REDUCES SHELF LIFE OF FRUITS

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ABSTRACT

Fungal plant pathogens have negative effects such as shortening shelf life, lowering product quality and wasting fruits and vegatables. In addition, chemicals used to inhibit fungal plant pathogen do not provide adequate yield and adversely affects human health. In particular, post-harvest activities cause to fungal diseases on fruits; therefore, more than 30% loss of the total yield of crops. Lactic acid bacteria (LAB) are of great interest in recent times because of their ability to produce antimicrobial substances like bacteriocin, hydrogen-peroxide and organic acids. These metabolites are inhibit spore germination and micelle growth. Today, lactic acid bacteria are a reliable alternative that can be used directly for biopreservation. A total of 16 lactic acid bacteria isolated from various sources (eg: raw cow milk, buffalo milk, goat milk) using 96-well agar plate and cell-free supernatant (CFS) inhibitory activity methods were screened for antifungal activity against the fungal plant pathogen such as *Aspergillus niger*, *Penicillium digitatum*, *Rhizopus stolonifer* and *Botrytis cinerea*. All isolated lactic acid bacteria were tested for their antagonistic ability to molds on agar. Lactic acid bacteria, which have both antagonistic effect and antifungal activity were tested on fruits. The isolates were characterized gram staining, catalase test and growth conditions on MRS agar. 14 isolates showed antifungal activity after 48 h and 120 h incubation at 37°C. LAB6, although there was well antifungal activity against *Aspergillus niger*, it did not show antifungal activity to the *Penicillium digitatum*. The bacterial supernatants and molds were grown using the cell-free supernatant method and incubated at 30°C for 48h. LAB 4.1 of supernatant reduced mass growth (%inhibition rate is %20) of fungi. These isolates inhibited the growth of mycelia and conidia germination of fungi, indicating the possibility of using LAB isolates as biopreservative.

Key words - Lactic acid bacteria, antifungal properties, probiotic, biopreservative

EDIBLE MACROFUNGI DETERMINED IN IYIDERE DISTRICT RIZE TURKEY

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ABSTRACT

Mushrooms are highly important for health as they have low calorie in addition to ingredients such as high protein, vitamin and nutrients. Of all the food, they are among the best vegetables and animal protein sources. The present study is aimed to contribute the mycobiota of Turkey as well as to raise the public awareness of the region about edible. Moreover, fungus can be handled as an alternative nutrient to lack of food for growing population of the world. The materials of the study comprise the patterns of fungus collected from İyidere (Rize / Turkey) district between 2015-2016. The morphological and etnomycological aspects of the fungus were identified and recorded. Their photos also were taken in their natural habitat and subtrate. Identification of the materials was carried out according to data obtained after determining microscobic properties of macrofungi taken to laboratory. As a result of the study, 32 edible macrofungus taxa belonging to Agaricomycetes and Pezizomycetes classes were determined.

Key words - Edible macrofungi, İyidere,Rize, Turkey

POSTER ABSTRACT

PRELIMINARY STUDY ON THE DETERMINATION OF HEAT RESISTANT FUNGI IN AGRICULTURAL SOILS

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ABSTRACT

Heat resistant fungi are capable of surviving temperature at short heat applications. These organisms continue to growing and metabolic activities. Therefore, they cause spoilage of food products and effect on health because of mycotoxin production. This study focused on determination of density and biodiversity of heat resistant fungi in agricultural soil samples. For this aim, two different soil samples were collected from agricultural lands at June 2018. Isolation process was performed by using main soil dilution method after heat treatment at 75 °C for 30 minutes of diluted soil samples. After incubation at 25 °C for 7-14 days, all colonies were purified. All of the isolates were diagnosed by using conventional methods according to the macromorphological and micromorphological properties. We determined 11 species belong to Alternaria, *Aspergillus*, *Cladosporium*, *Epicoccum*, *Humicola*, *Penicillium* and *Taloromyces* genera. As a result of this study, we showed that agricultural soil areas have a potential for heat resistance fungi biodiversity and exhibited that we should concentrate on this subject with investigation of different areas and sources.

Key words: agricultural soils, heat resistant fungi, conventional method

SEVEN NEW RECORDS BELONGING TO THE GENUS AGARICUS FOR TURKEY COLLECTED FROM THE AEGEAN REGION

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ABSTRACT

Turkey has advantages, such as the importance of compliance with the ecological conditions and geographic locations. Therefore, it has a rich diversity of macrofungi. In this context, our country is home to many species of macrofungi. The genus Agaricus L. is very popular in our country as it is in the world, especially because it has commercially important species like a *Agaricus bisporus* (J.E. Lange) Imbach. In addition to the edible species, there are species such as A. xanthodermus Genev which cause gastrointestinal disorders. In our country, there are 43 species belonging to the genus. It has been reported in previous studies that 26 of these species are found in Aegean Region. As can be understood from this information, the Aegean Region is a very suitable region for spread of the genus. With this study, the biodiversity of natural Agaricus members grown in the Aegean Region between 2015 and 2018 was examined and the number of species was updated to 41. Seven of the identified species are reported for the first time in our country. To determine the taxonomic location of the collected specimens, classical methods were used for some and both classical and phylogenetic studies were used for some. Molecular analysis of ITS (Internal Transcribed Spacer) barcode gene was used for some specimens which could not be identified in the absence of available literature sources. The descriptions of the species in the phylogenetic tree were obtained and compared with our specimens. Among the species identified in the study, *A.bernardiiformis* Bohus, *A. cupressicola* Bon & Grilli, *A. dulcidulus* Schulzer, *A. jacobi* L.A. Parra, A. Caball. & Callac, *A.matrum* L.A. Parra, A. Caball., S. Serrano, E. Fernández & Callac, *A. moellerianus* Bon and *A. porphyrocephalus* F.H. Møller species are new records for our country. Specimens which identified are preserved as fungarium material in the Cryptogam Research Laboratory, Muğla Sıtkı Koçman University. This research supported by Muğla S.K. University Scientific Research Projects Coordination Unit (BAP) project no: 17/102.

Key words - Agaricus, Aegean Region, Taxonomy, Macrofungi, ITS gene, New records

A NEW MONOTYPIC GENUS FOR TURKEY

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ABSTRACT

The genus Xerocoprinus Maire is a monotypic genus, which has the only species is *Xerocoprinus arenarius* (Pat.) Maire. This rare genus has been reported in some Mediterranean countries (Algeria, Morocco, Spain, Tunisia) and in North America (Mexico) on the world. Due to its rarity, it was referred to the IUCN (International Union for Conservation of Nature) for evaluation on the red list two years ago. In Turkey, coprinoid macrofungi are generally referred to as 'mürekkep mantarı –inky fungi-'. The reason that it is called with this name is that the gills break down in time as a result of chemical reaction called auto-digestion to form an ink-like black liquid. The only species of the genus, *Xerocoprinus arenarius*, is synonymous with *Coprinus arenarius*. The genus is often mistaken for the genus Coprinus Pers. Apart from molecular data, the most distinctive morphological features that distinguish the two genera are Xerocoprinus secotioid and Coprinus agaricoid frutification. Another difference is that the stem base of Xerocoprinus is clearly radicant. Xerocoprinus arenarius is a species mostly seen in spring and autumn, in semi-arid areas exposed to the sun, in sandy meadows, generally buried in soil. The specimen, which is the main material of the study, was collected from Kozak Plateau during the field survey conducted in April 2018. All morphological features were photographed visibly in the area. The locality information, along with its ecological characteristics, was recorded in the notebook. The numerated specimen, was transferred to Muğla Sıtkı Koçman University Cryptogam Research Laboratory in order to investigate the microscopic properties. The genus identified as a result of this study contributed to the diversity of macrofungi in our country.

Key words - Xerocoprinus, Kozak Plateau, Taxonomy, Macrofungi, Biodiversity.

BUTYRIBOLETUS FUSCOROSEUS A NEW RECORD FOR TURKISH MYCOTA FROM ISTANBUL PROVINCE

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ABSTRACT

The genus Butyriboletus D. Arora & J.L. Frank is known as "the butter Boletus" because of butter yellow color. Recently, this genus has been described from Boletus sect. Appendiculati and considered as a separate genus. This economically important genus has more than twenty species worldwide. Four Butyriboletus species reported from Turkey to date. The specimens were collected during the routine field studies at Fatih Natural Park in İstanbul. The morphological and habitat features of specimens were recorded and they photographed in day light. The specimens were identified by evaluating of the macroscopic, microscopic and habitat features in accordance with the current literatures. Butyriboletus fuscoroseus (Smotl.) Vizzini & Gelardi is reported as new record for Turkish mycota. This species is characterized by its pinkish-brown to brown rose-pink cap, bright yellow bruising blue pores, yellow reticulate stipe with tint of red or pink in the lower part. *Butyriboletus fuscoroseus* is close to *Boletus regius* (Krombh.) D. Arora & J.L. Frank and B. aereus Bull.. It distinguished from these species by its swollen stipe and decurrent pores. The blueing context of *B. fuscoroseus* occurs at pores, tubes and upper parts of stipe with slightly red at the base. *Butyriboletus fuscoroseus* is reported as a synonym of the *B. pseudoregius* (Heinr. Huber) D. Arora & J.L. Frank by several researchers, although they are considered as the separate species in the mycological database such as Index Fungorum and Mycobank. But, we agree these species as synonym in accordance with the researchers. The biodiversity of the genus Butyriboletus in Turkey is updated with five species with this study.

Key words - *Butyriboletus fuscoroseus*, new record, İstanbul, Turkey, Mycota

MICROFUNGI ASSOCIATED WITH HELLEBORUS ORIENTALIS IN YEDI GOLLER NATIONAL PARK

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ABSTRACT

Helleborus L. is a small genus in the family Ranunculaceae, distributed widely from middle, southern and eastern Europe to the borders of the Caucasus (Tanker & Bingöl 1984). There are two species native in Turkey. *Helleborus orientalis* Lam. has a very widespread distribution in North Anatolia. It grows in forest clearing and in the understorey. *Helleborus vesicarius* Aucher is an endemic species in Southern Anatolia distributed in the Amanos mountains, around Adıyaman, Hatay, Kahramanmaraş and in the Gaziantep province (Davis 1965). Plant specimen infected with microfungi was collected from Yedi Göller National Park in Bolu province of Turkey and prepared according to established herbarium techniques. Microscopical features were examined and microphotographs were made using a Leica DM E light microscope. The microfungi were identified using relevant literature. The examined specimens have been deposited in the mycological collection of the Ahi Evran University, Arts and Sciences Faculty, Mycology Laboratory in Kırşehir province of Turkey. As a result of field and laboratory studies, on *Helleborus orientalis* a total 5 species of microfungi were identified: *Ascochyta infuscans* Ellis & Everh., *Colletotrichum truncatum* (Schwein.) Andrus & W.D. Moore, *Microsphaeropsis hellebori* (Cooke & Massee) Aa, *Ramularia hellebori* Fuckel and *Pirottaea veneta* Sacc. & Speg. Of these, *Ascochyta infuscans* Ellis & Everh. is new record for Turkish mycobiota. Acknowledgments: This work was supported by the TUBİTAK (Project Number: 217Z038).

Key words - New record, microfungi, Turkey

PUCCINIA SPECIES PUCCINIALES FROM WESTERN TIEN SHAN AND TURKESTAN MOUNTAINS OF UZBEKISTAN

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ABSTRACT

The worldwide genus Puccinia, rusts, is largest genus in the Pucciniales, with approximately 4000 species reported up to the present. Members of this genus are serious pathogens on all major cereal crops and many other herbs. Although the rust mycobiota of Uzbekistan has been explored since the 20th century by different mycologists, the important rust fungi have largely been neglected, resulting in a very fragmentary knowledge of these fungi, particularly this study area. Based on the compilation of literature, re-checking of specimens in TASM herbarium, and species collected in field sampling, a total of 106 species of Puccinia were recorded in study area, including several species of economic importance. Among them 91 Puccinia species were reported from Western Tien Shan and 48 were recorded from the Turkestan Mountains. About 19 Puccinia species were recorded in the study area for first time. Species of Puccinia were discovered on 204 species of flowering plants, belonging to 31 families and 114 genera. The host families with the greatest number of Puccinia species were Compositae with 32 species, Poaceae with 17, Apiaceae with 15, Lamiaceae with 5, Polygonaceae with 5, and Cyperaceae with 4, and representing 74% of all Puccinia species present in the study area. Puccinia species were concentrated in the mountain ecoregions, with 80 species, and foothills, with 60 species. Mountains of Uzbekistan possess a rich flowering plant flora and therefore a diverse Puccinia species. Puccinia were most widespread in the middle of spring and end of summer. The most widespread types of development stage of Puccinia species are on host plants: Hemi-cyclic 49 species, Micro-cycle 27, Endo-cyclic 17, Eu-cyclic 15, and Opsi-cycle 7, with Brachy-cyclic development represented by 5 species. As expected, rusts that can live in multiple hosts were the most common, especially rusts that parasitize common, widespread plant species. Seventy-three of Puccinia species found are of the many-host type and the remaining 33 are of the single-host type. This work was supported by Ministry of Innovative Development of the Republic of Uzbekistan (Projects no. P3-2014-0830174425, no. P3-20170921183).

Key words - Rust fungi, Ecology, Host plants

MORPHOLOGICAL ANATOMICAL AND MOLECULAR DISTINCTION OF SYSTEMATICALLY CONFUSED *CLADONIA CONISTA* AND *CLADONIA HUMILIS*

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ABSTRACT

Cladonia genus is a very polymorphic genus. It is a genus with more than 400 species on worldwide. The some Cladonia species are known to be morphologically variable species. In recent years, the phylogeny of the genus Cladonia is under investigation. These studies are mostly in the form of comparison of groups or species. The genus Cladonia is divided into different infrageneric groups studied by many researchers in terms of phylogeny. The high morphological variability of Cladonia species is caused by factors such as light, temperature or humidity. *C. conista* and *C. humilis* in the *Cladonia chlorophaea* group are systematically confused with each other. Samples were collected from different regions of our country. The samples were examined under microscope and morphological and anatomical features were determined. The characters used to distinguish the species in the group include: the presence of sorediate in the podetium, farinose to granular soredia, corticate granules, corticate podetial stalk and the presence of bourgeanic acid or atranorin in the thallus. In this group, the secondary metabolites are fumarprotocetraric acid, bourgeanic acid and atranorin . DNA isolations of the samples were performed. A phylogenetic tree was constructed with ITS sequences. Although the species in the *Cladonia chlorophaea* group are similar, there are some distinctive differences. Morphological, anatomical and ecological differences of C. conista and C. humilis species were determined. Molecular differences are shown in the phylogenetic tree created with ITS sequences.

Key words - Lichen, *Cladonia conista*, *Cladonia humilis*, Systematic

MORPHOLOGICAL ANATOMICAL AND MOLECULAR DISTINCTION OF SYSTEMATICALLY CONFUSED *CLADONIA CONIOCRAEA* AND *CLADONIA OCHROCHLORA*

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ABSTRACT

Cladonia is one of the most common lichen species, which is widely distributed across all continents and includes more than 400 species worldwide. The genus Cladonia is divided into different groups that have been studied by many researchers in terms of phylogenetics. Although Cladonia is one of the most studied macrolichen species, it is known that some species of Cladonia are morphologically variable species. Recent studies based on molecular characters have confirmed this. The high morphological variability of Cladonia species is probably an effect of phenotypic plasticity caused by factors such as exposure to light, temperature or moisture. *C. coniocraea* and *C. ochrochlora* in the *Cladonia gracilis* group are systematically confused with each other. Samples were collected in field studies conducted in different regions of our country. Morphological and anatomical characteristics of the samples examined under microscope were determined. The characters used to distinguish the species in the group include: the presence of a partially sorediate or fully cortical podetia, the width of the podetial wall, the presence of squamules in the podetium, the presence of scyphi and diameters, and the color of the podetial base. In this group, the secondary metabolites are relatively uniform, most species containing only fumarprotocetraric acid. DNA isolations of the samples were performed. A phylogenetic tree based on ITS sequences was constructed. Species restriction in the *Cladonia gracilis* group is known to be difficult due to the morphological variability of taxa. Morphological, anatomical and ecological differences of *C. coniocraea* and *C. ochrochlora* species were determined. Molecular differences in its sequence analysis are also shown in the tree.

Key words - Lichen, *Cladonia coniocraea, Cladonia ochrochlora*, Systematic

TURKEY S YELLOW RUST *PUCCINIA STRIIFORMIS* F SP *TRITICI* AN EVALUATION ON THE IRREGULARITY OF DISEASE

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ABSTRACT

Wheat (Triticium sp.) Is one of the most important food sources during human history and it is among the cereals that are widely cultivated and produced in our country and in our world. As in the whole world, rust diseases are one of the most important fungal agents that limit wheat production and quality in our country. Epidemy/epidemics created by rust diseases cause significant yield and quality losses, threatening sustainable food safety and agriculture. In the control of yellow rust (*Puccinia striiformis* f. sp. *tritici*) disease, economic, environmentalist and durable varieties are used as a practical way. It is necessary to determine the variation in yellow rust disease for a sustainable resistance breeding program. Race change analysis studies conducted to date have been evaluated. As a result of these evaluations, Yr5, 10, 15, 24, 26 and 32 resistance genes were found to be effective in all growing areas. For sustainable breeding programs, it is necessary to follow the pathogenic variation of the yellow rust disease at the country level and revise the breeding programs as a result of the variation that may be experienced.

Key words - Wheat (Triticum sp.), Yellow rust (*Puccinia striiformis* f. sp. *tritici*), variation, race analysis, Turkey

PROTECTION OF FRUIT SALADS WITH NANO EMULSION OF SYNERGISTICALLY EFFECTIVE ESSENTIAL OILS

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ABSTRACT

Ready-to-eat fruit and vegetable products are extremely popular in the food industry, with a growing interest to achieve healthy food in the last decades. But according to the World Health Organization's data every year, almost 10% of the people suffer from foodborne illness, especially children. Research has shown that the majority of foodborne illness is caused by plant commodities -fruit and vegetables- generally eaten as raw. Due to the insufficient preservation methods for the preparation of a fresh-cut salad, spoiling is one of the biggest problems for shelf-life and food poisoning. Preservation with chemicals can cause severe damages to human health and nature. Therefore, researchers focused on natural preservatives, especially essential oils. In this study, three different essential oils used to prepare a nanoemulsion for increasing the shelf-life of a fresh cut fruit salad. Synergistic antifungal activity of the essential oils has also investigated. Since antimicrobial and antifungal properties of clove oil, cinnamon oil, black seed oil, and oregano oil are known, they are synergistically used against common post-harvest fruit pathogens. In vitro synergistic antifungal activity was studied in 96-well microplate assays against three common plant moulds and the mixture of these moulds. Black seed oil has observed to be less effective than the other essential oils in vitro antifungal assays. Clove oil, cinnamon oil, and oregano oil inhibited sporulation at 187,5 ppm so that these oils selected for nanoemulsion formulation. Nanoemulsion prepared with a size of 264 nm. Killerdose test was applied against ten common food pathogen bacteria. Nanoemulsion formulation has inhibited the growth of fungi mixture. Furthermore, significant data has been observed from antibacterial killer dose assay. A challenge test has applied on fruit salads for observing shelf life. For fruit trials apple, grape, and orange was selected. Penicillium spp. and Fusarium spp. moulds selected according to the fruit's natural pathogens. Also, an organoleptic analysis has been performed with ten people resulted in a 7 point out of ten. According to results, novel nanoemulsion formulation predicted to be a considerable preservative for increasing the shelf-life of ready-to-eat fruit salads. Challenge tests resulted as an increase of the shelf-life two times, compared to the chemical control, potassium sorbate. A further investigation can be performed on different fruits and vegetables.

Key words - Essential oils, synergistic, food preservatives, nanoemulsion, fresh-cut salad.

INVESTIGATION OF ANTIFUNGAL ACTIVITY OF ENDOPHYTIC YEASTS ISOLATED FROM PLANT TISSUES

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ABSTRACT

Postharvest diseases of fruits and vegetables cause significant losses and most of the rotting products have been found infected by fungi. Although the control of postharvest pathogens still relies mainly on the application of fungicides, there are strong public and scientific demands to reduce the use of chemical fungicides due to their carcinogenic impacts, residual toxicity, ecological pollution and particularly the development of the fungicide-resistant strains. Use of antagonistic microorganisms, plant-derived natural fungicides in harvested crops have great potential for management of the fruit and vegetable diseases at storage conditions. In this study, it was aimed to deal with the potentiality of endophytic yeasts as biocontrol agents against fungal pathogens. *Aspergillus niger* and *Penicillium digitatum* were the two significant ones out of four selected fungal pathogens. Endophytic yeasts are isolated from fresh asymptomatic and healthy leaves of different plants such as *Prunus laurocerasus, Ficus carica, Vitis vinifera, Corylus colurna*. Antifungal activities of isolated yeasts were studied in 96-well microplates against *Penicillium digitatum, Aspergillus niger*. As a noteworthy result MIC value of Colu7194 recorded as 106 cell/mL for 2 of the fungal pathogens that were tested. MIC values of both Vera7192 and Colu7191 recorded as 106 cell/mL against *Aspergillus niger*. Antagonistic Effect was studied in petri dishes against *Penicillium digitatum* and *Aspergillus niger*. Results showed that Colu7194 and Colu7196 inhibited sporulation, while Fica7191, Fica7194 and Colu7191 restricted the growth of *Aspergillus niger*. As a future perspective, yeasts that showed antifungal activity are going to be identified based on their ITS sequence and their mode of action will be investigated in order to be used as a biofungucide.

Key words - Endophytic yeast, Bioprospecting, Biocontrolling, *Aspergillus niger*, *Penicillium digitatum*

ENTOLOMA LAMPROPUS (FR.) HESLER A NEW RECORD FOR TURKISH MYCOBIOTA

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ABSTRACT

Entolomatoid mushrooms, pink gills attached to the stalk, a uniform thick cap, spor shapes and unique distinctive characters of spor prints make it easy to identify them. The genus Entoloma sp., (Entolomataceae, Agaricales, Basidiomycota), represented by about 1500 species worldwide, is one of the largest genera of Agaricales. Although some form mycorrhiza, most are saprophytes. According to the literature has been found 52 species of Entoloma until now in Turkey. In this study, *Entoloma lampropus* (Fr.) Hesler were collected and identified from Erzurum province and added to myocobiota of Turkey as a new record and the number of species was increased to 53.

Key words - Mycobiota, Turkey, Erzurum, new record, Entoloma

INVESTIGATION OF VOLATILE COMPONENT EFFECTS OF YEASTS ISOLATED FROM NATURE AGAINST MOLD GROWTH IN POST HARVEST STRAWBERRIES

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ABSTRACT

Strawberries are a typical soft fruit, have a high physiological postharvest activity with a short postharvest life. Post-harvest fresh fruits are usually delivered directly to supermarkets or shops, and after being in storage for a certain period of time, reaches the hands of consumers for consumption. The lack of post-harvest applications to strawberries further reduces shelf life. Proper management of these factors can significantly reduce the likelihood of infestation and result in a profitable harvest. This study aims to develop spray containing microbial mixtures with high biological control activity to maximize crop protection methods that can be used in post-harvest applications. The volatile component activity of 21 yeasts isolated from nature was observed on mold inoculated strawberries for 4 or 7 days at 4 °C and room temperature. Yeasts grown overnight in liquid medium that were spread on YPD medium using spreading techniques. Strawberries to be inoculated were transferred to plastic containers with three layers of moistened blotters at the bottom. Yeasts and moldy berries were evaluated for daily disease symptoms in the same container. The tested yeasts, 9 yeast delayed or prevented disease symptoms of inoculated fruits. The determined yeasts were tested by phytopathogenic application on strawberries. At the end of the test,no phytopathogenic properties were detected.The identification of these yeasts effective against mold was done by restriction analysis of the ITS region methods. As a result of this, Pichia fermentes,Pichia terricola,Meyerozyma guilliermondii and Meyerozyma caribbica species were identified as effective yeasts. However, Meyerozyma guilliermondii and Meyerozyma caribbica were determined as a human pathogen.Furthermore, Pichia fermentes and Pichia terricola of genetic similarities and differences between yeasts were phylogenetically determined,the use of these species for biological preservatives was not encountered in a risky situations. Future studies will involve the determination of the volatile constituents of effective yeasts.

Key words - post-harvest,strawberry, volatile components, yeast,shelf life

A NEW RECORD FOR TURKISH CONOCYBE

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ABSTRACT

Conocybe is a genus of family Bolbitiaceae within the order Agaricales (Basidiomycota). Although over 200 widely distributed species are currently exist, twenty-nine species have thus far been reported in Turkey. Fungal samples were collected from Onuncu yil campus area (formerly known as Tandogan Campus) of Ankara University. In the field, morphological and ecological features of the samples were recorded. In the laboratory, microscopic features were obtained by using both light microscopy (LM) and scanning electron microscopy (SEM). As a result, *Conocybe dentatomarginata* Watling (Bolbitiaceae) was reported for the first time from Turkey. A short description, ecology, distribution and photographs related to macro and micromorphologies of the species were given. With this study, species numbers of Turkish Conocybe increased to thirty. Acknowledgments Ankara University's Central Research Funding Unit (Project no: 18B0430001) is thanked for its financial support.

Key words - *Conocybe dentatomarginata*, new record,Ankara,Turkey

ECONOMICALLY VALUEABLE MUSHROOMS OF ARMUTLU YALOVA

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ABSTRACT

In this study totally 123 economically valuable macrofungi specimens have been collected from different localities of Armutlu (Yalova) province between 2010 and 2014. Necessary morphological and ecological characteristics of the samples were noted and they were photographed in their natural habitats. Fungal samples were further examined and micro-structural data were obtained by light microscopy (Carl Zeiss Primostar). Some reagents such as distilled water, Melzer's reagent, 5% KOH, H SO, Congo red etc. were used for microscopic investigations. Identification was performed according to Breitenbach and Kränzlin (1984–2000), H ansen and Knudsen (1992–2000), Ryvarden and Gilbertson (1993), Pegler et al. (1997), Calonge (1998), Kränzlin (2005) and Medardi (2006). As a result of field and laboratory studies, 23 species within the 16 families and 6 orders were identified. 2 of them belong to the division Ascomycota and 21 to Basidiomycota. The species list is given with the informations on localities, habitats, collecting dates and collection numbers.

Key words - Macrofungi, Armutlu, Yalova, Economic Macrofungi

DETERMINATION AND MOLECULAR IDENTIFICATION OF PENICILLIUM SPECIES CAPABLE OF BIOSYNTHESIS SILVER NANOPARTICLE AGNP

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ABSTRACT

Nanoparticles can be obtained by chemical, physical and biological methods. Basically, while the yields in physical methods are low, NPs obtained using chemical methods have harmful effects on the environment due to the use of toxic solvents and the renewal of hazardous by-products. By contrast, biological methods can produce cheap, desired size, stable and less toxic NPs. Silver nanoparticles have been shown to exhibit good conductivity, chemical stability, catalytic and antibacterial activities as well as a cytotoxic effect on cancer cells. Liquid medium containing reducing and stabilizing agents is generally used to synthesize nanoparticles. Under these conditions, the decrease of Ag + leads to the formation of Ag atoms. The resulting Ag agglomerates to oligomeric clusters and eventually results in Ag NP formation. In this study, Ag NP formation was determined by using UV-Vis spectrophotometry (Shimadzu UV 1800) by adding silver salt to the filtrates of Penicillium spp and molecular identification was made for these species.. In the PCR study, ITS1 ITS4 primers were used as universal primers. For Sanger Sequencing, the ABI 3730XL Sanger sequencing device (Applied Biosystems, Foster City, CA,USA) and the BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, Foster City, CA, USA) were used in the Macrogen Netherlands laboratory. The readings obtained with the ITS1 primers were contigued to form a consensus sequence. In this process, CAP contig assembly algorithm is used in BioEdit software. As a result of the sequence analysis, four different Penicillium species (*Penicillium toxicarium, Penicillium glabrum, Penicillium janthinellum, Penicillium chrysogenum*). were found to reduce silver salt into silver nanoparticles by visual observation of the fungal filtrates.

Key words - Penicillium, PCR, AgNP, UV Vis spectrophotometer

MORPHOLOGICAL AND GENETIC DIVERSITY OF *PENICILLIUM ROQUEFORTI* STRAINS ISOLATED FROM KONYA KUFLU TULUM CHEESE

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ABSTRACT

Penicillium roqueforti is the well-known filamentous fungus responsible for the blue-green color of mold-ripened cheeses. Konya mold-ripened tulum (kuflu) cheese is a famous variety of Turkish mold-ripened cheeses and is produced by cutting the mature tulum cheese into pieces to let the filamentous fungi grow on the surface in the cool and humid atmosphere of cellars or caves. This secondary maturation process does not involve any specific fungal starters; therefore, the resulting mycoflora is spontaneous, but is composed of mainly *P. roqueforti* strains. In this study, we isolated 55 filamentous fungi from 26 Konya mold-ripened Tulum cheese samples. ITS sequencing showed that 54 of these were *P. roqueforti* and one of them was *Cladosporium cladosporioides*. The morphological diversity of the *P. roqueforti* isolates were examined using four different media, potato dextrose agar (PDA), yeast extract sucrose agar (YES), malt extract agar (MEA) and oatmeal agar (OA). Morphological analysis resulted in seven different morphotypes of *P. roqueforti*. Rep-PCR conducted using GTG5 primer resulted in different patterns observed on agarose gel electrophoresis. Future studies will include differentiation of morphotypes by sequencing polymorphic loci and the effect of these morphotypes on cheese flavor. To our knowledge, this is the first study determining the Konya mold-ripened Tulum cheese mycoflora molecularly and analyzing the morphological and genetic diversity of Turkish *P. roqueforti* isolates.

Key words - Konya mold-ripened Tulum cheese, *Penicillium roqueforti*, ITS sequencing, morpotypes

IDENTIFICATION OF SOME MACROFUNGI SPECIMENS COLLECTED FROM MUGLA KOYCEGIZ REGION BY ITS GENE SEQUENCE ANALYSIS

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ABSTRACT

Aim of the study: In this study, molecular analyzes were conducted *Leucoagaricus bresadolae* (Schulzer) Bon & Boiffard, *Leucoagaricus leucothites* (Vittad.) Wasser, *Lepista sordida* (Schumach.) Singer, *Coprinopsis melanthina* (Fr.) Orstadius & E. Larss and *Psathyrella candolleana* (Fr.) Maire species in order to aid in identification. ITS barcode gene was used to distinguish between the samples for identification. Photographs, habitat and ecological characteristics of these species and a phylogenetic trees based on its ITS (internal transcribed spacer region of rDNA) gene region are obtained and taxonomic details regarding the species are discussed. Material and Methods: The samples used in this study were collected from Muğla / Köyceğiz region in Turkey. The macroscopic and microscopic features of the specimens were examined but some difficulties were encountered in the identification of the species and therefore the molecular studies were performed in addition to the classical methods. Molecular studies; For genomic DNA isolation of the specimens, the Qiagen DNeasy Plant Mini Kit was used and DNA isolation was performed. From the obtained genomic DNA, ITS gene region was amplified by PCR. For this, ITS1F and ITS4 primers were used. PCR products purified by the Fermentas GeneJET Gel Extraction Kit was sequenced. Using BioEdit Sequence Alignment Editor program, the quality of sequence peaks was evaluated based on the chromotograms. The resulting ITS gene sequences were analyzed via BlastN to obtain the closest nucleotide sequences in GenBank. Then, the resulting sequences were used to construct a phylogenetic trees using MEGA 7.0.26 program. The results obtained from the phylogenetic analysis and systematic data were evaluated and the samples were re-examined for species identification. Results: As a result, *Leucoagaricus bresadolae*, *Leucoagaricus leucothites*, *Lepista sordida*, *Coprinopsis melanthina* and *Psathyrella candolleana* species were determined. ITS gene sequence analysis once again proved to be efficient in the determination of the species and we suggest the use of ITS gene as a barcode gene for mushrooms in subsequent studies aimed to find new records and novel species. Acknowledgements: We would like to thank Muğla Sıtkı Koçman University BAP division (project no 17/105).

Key words - *Leucoagaricus bresadolae, Leucoagaricus leucothites, Lepista sordida, Coprinopsis melanthina, Psathyrella candolleana*, ITS Gene

TALAROMYCES CİNSİNE AİT BAZI STANDART SUSLARIN MODİFİYE CYA VE MEA BESİYERLERİNDEKİ KOLONİ MORFOLOJİLERİ

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ABSTRACT

Bu çalışmada, Talaromyces cinsine ait bazı standart küf suşlarının kültürasyonunda ve identifikasyonunda kullanılan bazı besiyerlerinin ve bunların modifiye edilmiş hallerinin koloni morfolojisine ve kültürasyon verimine etkisinin araştırılması amaçlanmaktadır. Yapılan deneylerde Talaromyces cinsine ait 5 farklı türün (*Talaromyces funiculosus, T. islandicus, T. piceus, T. rugulossus ve T. verruculosus*) belirli bazı suşları kullanılmıştır. Toplam 4 kontrol grubu besiyeri [Blakeslee's Malt extract Agar (=BL), Czapek Yeast Agar (=CYA Pitt ve =CYA Samson), ve Malt Extract Agar (=MR)] ve bunların üzerinde modifikasyonlar yapılıp, CYA'dan 3, BL'den 8 ve MR'den ise 2 farklı içerikli besiyeri elde edilmiştir ve uygun şartlarda ekim yapılarak inkübasyona bırakılıp sonuçlar gözlemlenmiştir. Modifiye besiyerlerinde, özellikle malt ekstrakt miktarı, glukoz ve pepton oranlarındaki farklar ve mikroelementlerdeki değişiklikler kontrol grubu besiyerindeki kendi miktarlarına göre değiştirilerek çalışma tamamlanmıştır. Sonuç olarak kontrol grupları ve modifiye edilmiş besiyerleri arasında makromorfolojik farklılıklar tespit edilmiştir. Özellikle kolonilerin renk ve tekstürü, sulkasyon, eksuda ve pigmentasyon oluşumu gibi farklılıklar ortaya çıkmıştır. Bu çalışmada en dikkat çeken modifiye besiyeri CYA 1 olmuştur. Çünkü çalıştığımız türlerde vejetatif miselyum yapısı diğer besiyerlerine göre daha çok olup, kolonide gözle görünen sporlanma daha az görülmüştür. Koloni morfolojisi kalitatif, koloni çapları ise kanditatif olarak değerlendirilmiştir. Özellikle miselyum yapısı ile çalışılması gerektiğinde bu besiyerinin kullanılması önerilmektedir. Bu çalışma Trakya Üniversitesi Bilimsel Araştırma Projeleri Birimi 2018/206 Nolu Proje ile desteklenmektir.

Key words - Talaromyces, Modifiye Besiyeri, CYA, MEA, Küf Koloni Morfolojisi

ISOLATION AND PARTIAL CHARACTERIZATION OF KERATINASE FROM TRICHOPHYTON SP.

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ABSTRACT

Keratins are insoluble structural proteins found in skin, hain, wool, feathers and nails. Keratin cannot be degraded easily by common proteolytic enzymes such as pepsin, trypsin, and papain. Keratinases (E.C.3.4.21/24/99.11) are common in microbial World and they are special and important group of proteases which degrade insoluble and protease resistant highly crosslinked keratin residues. In this study, production, isolation and partial characterization of keratinase from Trichophyton sp. strains have been reported. Trichophyton sp. was obtained from Kahramanmaraş Sutcu Imam University Dermatology polyclinic. Enzyme production was accomplished in mineral medium including keratin powder which served as a carbon source. The enzyme was purififed with Ammonium sulphate precipitacion, Sephadex G-100 column and DEAE Sepharose column chromatography. The optimal temperature for activity was determined by assaying activity between 20 and 45 oC for 60 min. pH optimum, pH and heat stability were assayed under standard enzyme conditions at optimum enzyme temperature. The effect of chemicals on keratinase activity was determined by adding of 1 and 5 mM of additives to the standard assay (Letourneau ve ark., 1998). For determination of homogenity and molecular weight, the enzyme preparations and known molecular weight markers were subjected to electrophoresis with the use of homogenized 10% acrylamide gel. The optimum pH and temperature Tr-9 keratinase were determined to be 7.5 and 37°C, respectively. The activity of keratinase was stable in the pH range 5.5-8.0 for 30 min and temperatures from 20-40°C. CaCI2 (5mM) showed a stimulatory effect on keratinase activity (148 %) on the other hand, EDTA (5mM) and SDS (1%) inhibited enzyme partially as 49 %, 49 % respectively. The molecular weight of keratinase was estimated to be 34 kDa by SDS page. The results show that if Tr-9 keratinase gene is transferred to another non-pathogenic industrial microorganism it will be more functional, such as industrial and biotechnological applications requiring keratinolisis, pruducing feather meal.

Key words - Trichophyton sp., Keratinaze,Enzyme, characterization

DETERMINATION OF ANTIFUNGAL METABOLITE PRODUCTION CAPACITIES OF MICROFUNGUS ISOLATED FROM THE CAMALTI SALTERN USING DIFFERENT METHODS

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ABSTRACT

Halotolerant fungi have characteristics to produce unique secondary metabolites because of adapting to live in extreme habitats. Halotolerant fungi adapt extreme conditions, where most living organisms have difficulty to survive in, through activating their silent genes and inducing their biosynthetic pathways. Secondary metabolites of halotolerant fungi which are isolated from extreme salty niches are very important for discovering new bioactive substances. In this study, the antifungal metabolites (especially griseofulvin and griseofulvin-like) production abilities of 29 species belonging to the genera Penicillium and Aspergillus was determined by several methods. Fungal isolates which were isolated from İzmir Çamaltı Saltern in our previous studies, identified by classical and molecular methods and preserved in our laboratory culture collection were used. Several different methods have been used for screening antifungal metabolites. (i) Rapid methanol extraction and separation of extracts by thin layer chromatography, (ii) determination of antifungal activity by TLC-Bioautography, (iii) agar diffusion (CLSI M44-A) method to determine the presence of bioactive metabolite. It has been found that these methods have advantages and disadvantages in the determination of their antifungal metabolite production capabilities. The fastest and most effective results were obtained by agar block method performed by agar diffusion technique. Fungal metabolites extracted by methanol successfully screened by thin layer chromatography. No results were obtained with the TLC-Bioautography methods. As a result, it was determined that 12 isolates produced antifungal metabolites. Among these isolates, Penicillium griseofulvum CT725 was found to have the highest antifungal activity. It is important to discover new fungal metabolites with strong antifungal activity. In fungal metabolite screening studies, modified agar diffusion technique provides the most effective result in the shortest time. Furthermore, P. griseofulvum CT725, which is determined to have the highest anticandidal activity, is important as a new potential griseofulvum or derivative producer.

Key words - metabolites, antifungal, screening, halotolerant

IMPORTANCE OF THERMAL WATER RESOURCES IN THE DISCOVERY OF NEW ANTIMICROBIAL

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ABSTRACT

Antimicrobial agents have been used for 80 years in the treatment of infectious diseases which are a great danger to human health. The widespread and unconscious use of antimicrobial agents has resulted in the development of resistance. Pathogenic microorganisms resistant to all antimicrobials in use, pose great risk to human health. It is not possible to develop the drug at the same rate against the rapidly developing resistance. Therefore, the discovery of new antimicrobial agents has become a necessity. A lot of research has been done to determine the antimicrobial properties of new metabolites obtained from microorganisms isolated from extreme environments. Thermal and mineral waters have been used by people for the treatment of many diseases for a long time. In such environments, heat-induced microbial compounds have been shown to play a bioactive role in helping to alleviate pain and treat certain infections. These include urinary tract infections and infectious diseases such as dermatitis. Some studies on hot water resources, antimicrobial effect of water and metabolites produced by microorganisms isolated from these regions have been found to pose antimicrobial effect. However, these studies are still in the early stages. The results obtained from the limited studies reveal many difficulties in the discovery and production of new antibiotics from thermal water sources. Optimum production of isolated microorganisms and the development of new techniques for the determination of metabolites can be determined by studies in this area. In this review, it is thought that the results obtained from the studies carried out in this field from the past to the present will be evaluated and will guide the studies to be done from now on.

Key words - Antimicrobial, thermal water, extreme environments

AMYLOLYTIC ACTIVITY OF MICROFUNGI ISOLATED FROM HYPERSALINE ENVIRONMENTS

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ABSTRACT

Filamentous fungi are characterized by their ability to produce high amounts of various extracellular enzymes. Fungal amylases are frequently obtained for both industrial and research purposes. The amount of amylase production differs in each microorganism to microorganism and even in genus, species and strain. Factors affecting amylase production such as pH, temperature, carbon and nitrogen sources in amylase production are also important in fermentation process. In this study, it was aimed to select a suitable producer from microfungi isolated from hypersaline enviroments, for the production of laboratory scale through submerged fermentation of a-amylase enzyme. Previously isolated fungi from İzmir Çamaltı Saltern and preserved in the culture collection of Eskişehir Osmangazi University Biology Department were used. Amylase activity of these fungi were determined qualitatively by agar block disc diffusion method. Potato Dextrose Agar blocks obtained from 29 Aspergillus species were incubated at 27 ℃ for 72 hours and placed under aseptic conditions in starch agar media containing 0%, 5%, 7%, 12% and 17% salt ratio. After incubation for 7 days, the degree of amylolytic activity was determined according to the transparent zone diameter formed after starch-iodine assay. The species with the highest activity were determined as *Aspergillus clavatus*, *A. tamarii* and *A. sydowii*, respectively. It was shown that all three fungi had an activity on starch agar medium containing 5% 7% and 12% salt. Furthermore *A. sydowii* and *A. tamarii* species showed amylase activity on medium containing 17% salt concentration. As a result, these three organisms isolated from hypersaline environments would be considered as potential fungal amylase producers and also enzymes produced from these organisms could show activity in salt related processes.

Key words - Fungal Amylase, fermentation, bioprocess, enzyme

PULVINULA ALBA A NEW ASCOMYCETE RECORD FOR TURKEY

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ABSTRACT

Pulvinula Boud. is an ascomycete genus within the family Pyronemataceae, and mainly characterized by the discoid to pulvinate apothecia, presence of carotenoid pigments, apically curved or hooked to deformed paraphyses and globose (rarely ellipsoid) ascospores. Kirk et al. gives the worldwide existing number of Pulvinula as 27, five, *Pulvinula archeri* (Berk.) Rifai, *P. carbonaria* (Fuckel) Boud., *P. convexella* (P.Karst.) Pfister, *P. johannis* Lantieri and *P. laeterubra* (Rehm) Pfister, of which were also reported from Turkey. Here we present *P. alba* (Velen.) Svrček as the sixth member of the genus in Turkey. The study aims to make a contribution to the mycobiota of Turkey. Fruit bodies were collected from Tonya district of Trabzon province. As a result of field and laboratory investigations, the samples were identified as *P. alba* with the help of relevant literature. Tracing the current checklists and latests records on Turkish macrofungi, it was found that it has not been reported before from Turkey. The taxon has a 0.5 to 2 mm wide, nonstipulate, creamy white and discoid fruit bodies, cylindrical and 8-spored asci, cylindrical, septate and apically curved paraphyses, and spherical and uniguttulate ascospores. A brief description of the taxon is provided together with its distributions and photographs related to its macro and micromorphologies. Acknowledgment: The authors would like to thank Karamanoğlu Mehmetbey University Research Fund (02-D-17) for its financial support.

Key words - biodiversity, new record, Pezizales, Turkey

ELAPHOMYCES MUTABILIS A NEW RECORD FOR TURKEY

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ABSTRACT

Elaphomyces Nees, also known as deer fungus, is a hypogeous genus in the family Elaphomycetaceae. The members of the genus are generally characterized by globose to subglobose or irregular hypogeous ascomata; fleshy to leathery peridium; a single chamber gleba; a more or less powdery spore mass; globose to subglobose asci; and subglobose to globose ascospores with spiny to verrucose ornaments. The genus Elaphomyces is a widespread one and Kirk et al. mentions about the existence of 25 members worldwide. Four members, *E. granulatus* Fr., *E. leucocarpus* Vittad., *E. muricatus* Fr. and *E. septatus* Vittad., of the genus have also been reported from Turkey. Here we present *E. mutabilis* Vittad. as a new member of the genus for Turkey, and aim to make a contribution the mycobiota of Turkey. Fruit bodies were collected from İstanbul, Rize and Trabzon provinces. As a result of field and laboratory investigations, the samples were identified as E. mutabilis with the help of relevant literature. Tracing the current checklists and latests records on Turkish macrofungi, it was found that it has not been reported before from Turkey. A brief description of the taxon is provided together with its distributions and photographs related to its macro and micromorphologies. Acknowledgment: The authors would like to thank Karamanoğlu Mehmetbey University Research Fund (02-M-15 and 16-M-16) for its financial support.

Key words - biodiversity, hypogeous fungi, new record, Turkey

IN VITRO PREBIOTIC ACTIVITY OF POLYSACCHARIDES EXTRACTED FROM *TRAMETES VERSICOLOR* BY USING OF LASER NEPHELOMETRY

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ABSTRACT

Prebiotics are nondigestible food components or ingredients mainly including oligosaccharides which have a positive influence on the host by their selective growth or activation of certain bacterial species present in intestines. Mushrooms are rich in nondigestible dietary fibers belonging to β-Glucan, chitin, mannan, xylan, galactose and hemicellulose, etc. In this study, the in vitro prebiotic activity of *Trametes versicolor* polysaccharides (TVP) was investigated. For this purpose, the growth of *Lactobacillus plantarum, Lactobacillus acidophilus* and *Escherichia coli* bacteria in presence of 0.25%, 0.5%, 1.0% and 2% concentrations mushroom polysaccharides was monitored nephometrically in microplate wells during 48 hours. The growth of the bacterias every hour intervals during the incubation period using the nephelometry as RNU (relative nephelometric unit), was expressed. Glucose and inulin were used as a negative and positive control group, respectively. The results acquired in this study indicated that the highest in vitro prebiotic activity was obtained in the 0.25% dose of TVP for growth of *Lactobacillus plantarum* and *Lactobacillus acidophilus*. The mean RNU values for *Lactobacillus plantarum* and *Lactobacillus acidophilus* growth were 50,41 and 34,67, respectively, which were comparable with the positive control, inulin. Besides TVP has inhibited to Escherichia coli growth in all concentrations. Based on the obtained results, we can argue that TVP has high in vitro prebiotic activity in especially 0,25% concentration and can be a good candidate for a in vivo prebiotic activity study.

Key words - Nephelometry, Prebiotic, Trametes versicolor

CONSTRUCTION MATERIAL AND LEATHER PRODUCTION FROM FUNGI

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ABSTRACT

Some of the fungi used in the production of composite materials in the literature are Trametes sp and *Ganoderma* sp. In the experimental stage, one of these fungi is selected and then the development of spore or mycelium is provided. Mycelia developed on rye grains are inoculated in the substrate. The high cellulose content of the substrate in construction material production is important both to reduce contamination from other organisms and to obtain hard and durable material. The substrate inoculated with mycelium is placed in plastic molds and incubated for 8 weeks at 28°C. To stop the growth of mycelium, dry at 80°C until the weight is stabilized. For example, bricks are produced in this way. Modern methods used in the production of fungi-based leather, mycelium is produced primarily on cotton felt in leather production. Subsequently, this mycelium-coated material is subjected to wetting, drying, plasticization and mechanical processes respectively and the product is obtained. *Fomes fomentarius, Phellinus ellipsoideus* and *Ganoderma lucidum* used in leather production. Although few companies make these productions, technical knowledge is limited. In this review, environmental, mycelium-based construction materials and leather products are introduced in the world. Our laboratory has been initiated preliminary studies on the subject are underway to bring the research project stage.

Key words - Mycelium, composite material, green composite, mycelium based material, mycelium composite

ISOLATION OF ADAPTED SPECIES IN RATTLETRAP FIGS

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ABSTRACT

Dried figs are among the important agricultural products in Turkey's dried fruit exports. According to FAO data in the world (2012-2013 years) average of 102 thousand tons of dried figs exports made in 2013, of which approximately 64% was carried out by Turkey. Microbial formations detected in dried figs, especially the presence of aflatoxin adversely affect the export of dried figs. Every year, approximately 10% of the yield is allocated as rattletrap figs. In this study, adapted species in rattletrap figs were determined. 1 kg dried fig samples were scraped from a private fig production company and were first examined under a UV lamp in Aydın Adnan Menderes University Biology Department Microbiology Laboratory. Dried fig samples containing aflatoxin emit blue-green radiation under the UV lamp. The irradiating samples (about 600 g) were cut into small pieces under sterile conditions. 50 grams of cut samples were taken and mixed with 450 ml of physiological water until homogenous in the blender. 25 ml of this homogenate were removed and mixed with 225 ml of physiological water and diluted 6 times in a 1: 9 ratio. Nutrient Agar and Rose Bengal Chloramphenicol Agar (RBCA) smearing was performed at each dilution rate. Nutrient Agar Petri dishes were incubated at 30 0C and 37 0C for 24-48 hours, RBC Agar Petri dishes 27 0C for 5-7 days. After incubation, the samples were stained with Lactophenol Blue for fungi, gram stained for bacteria and morphological identification under an Olympus microscope. As a result of the study, Aspergillus and Rhizopus were isolated in Rose Bengal Chloramphenicol Agar and Staphylococcus was isolated in Nutrient Agar. In our study was determined Aspergillus as aflatoxin-producing fungi.

Key words - Dry fig, aflatoxin, Aspergillus

MOLECULAR IDENTIFICATION OF TRICHODERMA SPP USED AS BIOCONTROL AGENTS BY DNA BARCODING

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ABSTRACT

Trichoderma spp. possess many commercially important features such as their role as effective biological control agents and plant growth-promoting fungi. In present study, it was aimed to carry out molecular identification of 11 isolates of Trichoderma spp. which known to be a biological control agent. For this purpose, all isolates were firstly incubated on Potato Dextrose Agar at 28±2 oC in the dark for 7 d and the spore solutions from each of the cultures were prepared. After preparation spore solution, the spores were transferred to Malt Extract Broth medium and then liquid cultures were incubated to produce mycelia for genomic DNA isolation for 4 d at 28±2 oC in a shaking incubator. The mycelia were separated from the liquid medium by filtration. For fungal cell wall lysis, the sterile metal beads and tissue lyser were used. After fungal cell wall lysis, genomic DNAs were extracted with Plant Genomic DNA Purification Kit.The Internal Transcribed Spacer (ITS) gene and Elongation Factor (EF) gene regions of these DNAs, in which the purities were measured on nanodrop and single band images were taken on the agarose gel, were amplified with Polymerase Chain Reaction and then amplicons was sequenced. By comparing fungal ITS and EF nucleotide sequences deposited in NCBI-GenBank using Basic Local Alignment Search Tool (BLAST) program, all of the isolates were identified to species level as T. citrinoviride (n=6) and T. atroviride (n=5). In addition, TrichOKEY and TrichoBLAST search tools was used to assess the reliability of NCBI-BLAST. Then nucleotide sequences belong to the ITS and EF gene regions for all species have been deposited at NCBI-GenBank and the phylogenetic trees were constructed using these nucleotide sequences. This study also was described polymorphic region in the nucleotide sequence of partial ITS and EF gene regions for both species.Therefore, the unique primers will be designed for T. citrinoviride and T. atroviride. Acknowledgements This study was supported by Ege University Scientific Research Projects Coordination Unit (Project number 15-MÜH-059).

Key words - Trichodermasp., molecular identification, internal transcribed spacer region, elongation factor region, phylogenetic diversity analysis, DNA Barcoding

ANTIFUNGAL EFFECT OF *NEPETA CATARIA* L.

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ABSTRACT

Medicinal plants are always of great importance for human beings because of their valuable components and bioactive properties. *Nepata cataria* is a medicinal and aromatic plant belonging to L. Lamiaceae. *Nepata cataria*'s fresh or dried flowers and leaves are used in sauce, soup and cheese making. The tea made from leaves has a sedative effect. It is also known to have biological activities such as diarrhea, cough, bronchitis, asthma and alleviating gastrointestinal and respiratory disorders. In this study, antifungal activity of extracts of flowers, leaves and stems of Nepeta cataria obtained by using methanol solvent was determined according to disc diffusion method. For the study *Candida albicans* FMC17, *Candida tropicalis* ATCC13803 and *Candida glabrata* ATCC66032 as yeast, from dermatophytes, Trichophyton sp. and Epidermophyton sp. microorganisms were used. Nystatin, the standard antifungal agent, was used as a positive control in the study. According to the results obtained, methanol extracts of flower, leave and stem parts of *Nepeta cataria* inhibited the growth of yeasts and dermatophytes at different rates (8-22 mm). The highest inhibition zone against yeasts was detected against *C. albicans* (22 mm) in methanol extract of *Nepeta cataria* leaf part. The highest antifungal activity against dermatophytes was detected against Epidermophyton sp. (12 mm) in methanol extract of *Nepeta cataria* stem part.

Key words - Medicinal plant, *Nepeta cataria*, Antifungal activity, Fungi, Dermatophytes

THE IDENTIFICATION OF MALASSEZIA SPECIES ISOLATED FROM THE HEAD OF PATIENTS WITH TINEA VERSICOLOR IN MASHHAD IRAN

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ABSTRACT

Malassezia species are lipophilic yeasts recognized as skin commensals that may be pathogenic under certain conditions. Malassezia genus has been associated with a number of diseases affecting the human skin, such as pityriasis versicolor. In addition, Malassezia yeasts are associated with clinical complication such as tinea versicolor, seborrheic dermatitis and folliculitis. This study was conducted in order to determine the dominant species of Malassezia genus producing tinea versicolor in Mashhad. 92 of patients with tinea versicolor, the specimens were taken from the different parts on head. The scalps were cultured on Dixon agar medium and incubated at 32 °C. One-hundred Malassezia colonies were collected and the genomic DNA were extracted by phenol–chloroform method. The PCR assay was performed on the 26s rDNA region. The PCR products were exposed to CfoI restrictive enzyme in order to nucleotides to be dispersed based on different Malassezia. There was a statistically significant difference in the frequency of tinea versicolor between women (43%) and men (57%). The highest prevalence of tinea versicolor was seen in patients 21–30 years-of-age. Malassezia species were mainly isolated from the head scalps than the other organs. The most commonly isolated Malassezia species in the study were; *M. globosa* (39%), *M. globosa/M. restricta* (31%), *M. restricta* (12%), *M. sympodialis* (7%), *M. sympodialis/M. restricta* (4%), *M. globosa/M. restricta/M. furfur* (2%), *M. sympodialis/M. restricta/ M. globosa* (1%) and unknown species (4%). The study showed that M. globosa is the most common Malassezia species in the patients with tinea versicolor in Mashhad. In addition, 38% of Malassezia species were mixed in the head skin disorders. The PCR-RFLP seems to be a useful method in rapid identification of the Malassezia species.

Key words - Malassezia; Tinea versicolor; species; PCR-RFLP

KONYA BEYŞEHİR YOL GÜZERGAHINDAN BAZI MİKSOMİSETLER

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ABSTRACT

Miksomisetler, ülkemizde cıvık mantar olarak bilinen literatürde ise balçık kalıp (slime mold) olarak isimlendirilen ancak ima edilen ismine göre kalıp değil, sümüksü yapıdadır. Myxomycetes, aynı zamanda Mycetozoa veya Myxogastria olarak bilinen yıllardır mantarlar aleminin özel bir grubu olarak kabul edilen amoeboid protistlerin bir grubudur. En küçük haldeyken bile orman içinde sürünerek hareket eder ve beslenerek büyürler. Plasmodium, olgun sporokarp oluncaya kadar bitkisel organik döküntüler üzerinde hareket eder. Türkiye miksomisetleri ile ilgili ilk çalışma 1957 yılında yayınlanmıştır. Günümüze kadar 252 miksomiset taksonu tespit edilmiştir. Miksomisetlerle ilgili çalışmalara son 10 yıl içinde ilgi artmış ve literatür sayısı da artmıştır. Miksomisetler orman döküntü katında yaşayan, milimetrik yapıda olan olağanüstü güzelliklere sahip canlılardır. İnsanlar tarafından fazla bilinmeyen bu organizmalarla mikologlar haricinde farklı alanlarda çalışan bilim insanları ve sanatçılar da ilgilenmektedir. Bu çalışma, S.Ü. Fen Bilimleri Enstitüsü "Konya–Beyşehir Yol Güzergahındaki Miksomisetler Üzerine Bir Araştırma" isimli yüksek lisans tez çalışmasının bir kısmıdır. Materyaller 2019 yılında Konya-Beyşehir arasındaki Altınapa Barajı ve Kent Ormanı civarından Mayıs ayında yapılan arazi çalışmalarında canlı ağaç kabukları ve orman döküntü katından miksomisetlerin gelişebileceği materyaller toplanmıştır. İlk arazi çalışmasında yaklaşık 30 materyal toplanmıştır. S.Ü. Mantarcılık Uygulama ve Araştırma Merkezi bünyesinde bulunan mantar yetiştirme kültür odalarında nem odası kültürüyle materyaller nemlendirilmiş ve gün aşırı stereomikroskop altında gelişmeler takip edilmiştir. Gelişen örnekler subtratlarıyla mukavvalara yapıştırılıp kutulara yerleştirilerek koruma altına alınmıştır. Elde edilen ilk sonuçlarla materyallerin 22'sinde gelişme olmuş ve 10 taksonun teşhisi yapılmıştır. Taksonların cinslere göre dağılımı ise Perichaena (3), Didymium (2), Arcyria (1), Badhamia (1), Echinostelium (1), Macrolepiota (1) ve Physarum (1) şeklinde belirlenmiştir. Çalışmamızın arazi ve laboratuvar çalışmaları devam etmektedir. Miksomiset örnekleri ise fungaryum materyali halinde S.Ü. Mantarcılık Uygulama ve Araştırma Merkezi Fungaryumu'nda saklanmaktadır.

Key words - Myxomycetes, slime mold, Mycetoza, Myxogastria, sporokarp, Türkiye

EVALUATION OF SLIME MOULDS AS A DIFFERENT SOURCES OF ANTIBIOTICS

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ABSTRACT

The true slime moulds are a special group of primitive phagotrophic eukaryotes. Because of having similar characteristics to lower animal groups on one side and with fungi on the other side, they are an unusual unique group of microorganisms. They produce sporocarp-bearing spores similar to fungi. Also, they show a plasmodial stage in the life cycle with amoeboid movement which is similar to protozoans. But today they are separated from both these groups and investigated into a separate group called "myxomycetes". More than 100 secondary metabolites have been isolated from myxomycetes and some of them have biological properties like antimicrobial, antioxidant and anticancer. Especially antimicrobial compounds have been isolated from both sporophores and plasmodia of various species of myxomycetes but it is not too easy to provide them. The number of sporophore of a particular species appearing in the nature is usually limited except for a few species that achieve considerable size (e.g., *Fuligo septica* and *Lycogala epidendrum*), and the plasmodia of most species of myxomycete are difficult to culture. Among myxomycetes species especially Phsarales members are preferred for researches of bioactive compounds because of their easy cultivation and forming large size of plasmodia. According to the previous studies, generally, it was found that myxomycetes have the strongest activity against Gram-positive bacteria (e.g. *Bacillus subtilis*), followed by fungi (e.g. *Candida albicans*) and finally with low or no inhibition effects on Gram-negative bacteria. Also, the compounds like Cribrarione A and B, Bahiensol, Melleumin A and B, Enteredinine A and B, Lycogalinoside A and B, etc. are recorded as antimicrobial agents and effective against some microorganisms but it is not so clear in some studies whether antimicrobial activity is due to secondary compound or plasmodium of the myxomycetes. The aim of this review is to draw attention to the fact that myxomycetes may be a potential antibiotic source against many microorganisms with new studies that can be performed outside of taxonomic studies. Thus, these organisms will become more valuable with the researches carried out and will stand out in terms of their place among other living organisms.

Key words - slime moulds, antibiotic, antimicrobial compounds, plasmodium, fruiting bodies

COMPARISON OF TOTAL AFLATOXIN IN PACKAGED AND UNPACKAGED WHEAT SAMPLES BY ELISA METHOD

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ABSTRACT

This study was designed to determination the total aflatoxin levels of wheat grain. For this purpose, fifteen unpackaged and fifteen packaged wheat samples collected from different places of İstanbul. Each sample prepared in 10 grams packages with aseptic ways and storage in the defreeze in order examination in the laboratory. It was used Ridascreen Aflatoxin Total Elisa Kit which is a competitive enzyme-linked immunosorbent assay (ELISA) for the quantitative analysis of aflatoxins in cereals and feed. Expected results were obtained using elisa reader and standards for aflatoxin. Total aflatoxin values were observed between ≤ 1.75 and 2.43 ppb. When compared the Elisa test results in packaged and unpackaged wheat samples, there is no significant difference for aflatoxin. In this study isolated Aspergillus spp for 7 samples among them. While Aspergillus spp isolated in 40% of unpacked samples, 6.6% of packed samples. We have no isolated aflatoxin producing Aspergillus spp. It was observed that was suitable culture and elisa test results. There are already some studies on the level of mycotoxin in different foods consumed and produced in Turkey. Because wheat is susceptible to these fungi infections through its growth, harvest, transport and storage is the most staple food in our country, aflatoxin test must be done routinely.

Key words - Total aflatoxin, ELISA, Turkey, wheat, Mycotoxin

IN VITRO ANTIMICROBIAL ACTIVITY OF *DESARMILLARIA TABESCENS*

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ABSTRACT

Mushrooms are known to be nutritive and medicinal food stuff, which are good sources of some vitamins and essential minerals. They also contain some therapeutic agents, thus they have been used against several health problems for hundreds of years. The aim of this study is to determine the in vitro antimicrobial activity of *Desarmillaria tabescens* (Scop.) R.A. Koch & Aime. *D. tabescens* samples were air dried and extracted by using ethanol. Antimicrobial activity of D. tabescens ethanol extracts were investigated against several Gram positive and Gram negative bacteria strains, fungal strains, which are either standard or isolated from food and some multi drug resistant (MDR) clinical isolate bacteria namely, *Bacillus subtilis* DSMZ 1971, *Candida albicans* DSMZ 1386, *Enterobacter aerogenes* ATCC 13048, *Enterococcus durans*, *Enterococcus faecalis* ATCC 29212, *Enterococcus faecium*, *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae*, *Listeria innocua*, *Listeria monocytogenes* ATCC 7644, *Pseudomonas aeruginosa* DSMZ 5071, *Pseudomonas fluorescence* P1, *Salmonella enteritidis* ATCC 13075, *Salmonella infantis*, *Salmonella kentucky*, *Salmonella typhimurium* SL 1344, *Staphylococcus aureus* ATCC 25923, *Staphylococcus epidermidis* DSMZ 20044, *Staphylococcus aureus* (MDR), *Escherichia coli* (MDR), *Klebsiella pneumoniae* (MDR), *Acinetobacter baumannii* (MDR) and *Streptococcus pneumoniae* (MDR) by using the disk diffusion method. As a result, it was observed that ethanol extracts of D. tabescens has low to medium antimicrobial activity against several Gram positive and Gram negative microorganisms tested. The antimicrobial activity of *D. tabescens* especially observed against *K. pneumoniae* (MDR) and *S. pneumoniae* (MDR) is found to be remarkable.

Key words - *Desarmillaria tabescens*, antimicrobial activity, disk diffusion, multi drug resistant bacteria, MDR

IN VITRO ANTIMICROBIAL ACTIVITY OF *MORCHELLA ESCULENTA* AND *TRAMETES VERSICOLOR*

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ABSTRACT

Fungi have a potential of using both as nutritive and medicinal food stuff. Because of containing several therapeutic agents, they are reported to be used for hundreds of years to treat several diseases caused by bacteria, fungi, viruses and parasites. The aim of this study is to determine the in vitro antimicrobial activity of *Morchella esculenta* (L.) Pers. 1801 and *Trametes versicolor* (L.) Lloyd 1921. *M. esculenta* and *T. versicolor* samples were air dried and extracted by using ethanol. Antimicrobial activity of *M. esculenta* and *T. versicolor* ethanol extracts were investigated against several Gram positive and Gram negative bacteria strains, fungal strains, which are either standard or isolated from food and some multi drug resistant (MDR) clinical isolate bacteria namely, *Bacillus subtilis* DSMZ 1971, *Candida albicans* DSMZ 1386, *Enterobacter aerogenes* ATCC 13048, *Enterococcus durans*, *Enterococcus faecalis* ATCC 29212, *Enterococcus faecium*, *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae*, *Listeria innocua*, *Listeria monocytogenes* ATCC 7644, *Pseudomonas aeruginosa* DSMZ 5071, *Pseudomonas fluorescence* P1, *Salmonella enteritidis* ATCC 13075, *Salmonella infantis*, *Salmonella kentucky*, *Salmonella typhimurium* SL 1344, *Staphylococcus aureus* ATCC 25923, *Staphylococcus epidermidis* DSMZ 20044, *Staphylococcus aureus* (MDR), *Escherichia coli* (MDR), *Klebsiella pneumoniae* (MDR), *Acinetobacter baumannii* (MDR), *Proteus vulgaris* (MDR) *Serratia odorifera* (MDR) and *Streptococcus pneumoniae* (MDR) by using the disk diffusion method. As a result, it was observed that ethanol extracts of *M. esculenta* has medium to high antimicrobial activity against several Gram positive and Gram negative microorganisms tested, where *T. versicolor* presented low to high antimicrobial activity. The antimicrobial activity of M. esculenta especially observed against *E. faecium*, *S. epidermidis*, *K. pneumoniae* (MDR), *P. vulgaris* (MDR) and *S. pneumoniae* (MDR), and the antimicrobial activity of *T. versicolor* especially observed against *E. faecium*, *S. odorifera* (MDR) and *S. pneumoniae* (MDR) is found to be remarkable.

Key words - *Morchella esculenta*, *Trametes versicolor*, antimicrobial activity, disk diffusion, multi drug resistant bacteria, MDR

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