



The gilled fungi and boletes of Iran: diversity, systematics, and nrDNA data

M. Ghobad-Nejhad ✉

Department of Biotechnology, Iranian Research Organization for Science and Technology (IROST), Tehran, Iran

E. Langer

Department of Ecology, University of Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

V. Antonín

Department of Botany, Moravian Museum, Zelný trh 6, 659 37 Brno, Czech Republic

G. Gates

Tasmanian Institute of Agriculture, Private Bag 98, Hobart, Tasmania 7001, Australia

J. Noroozi

Department of Botany and Biodiversity Research, University of Vienna, Austria

R. Zare

Department of Botany, Iranian Research Institute of Plant Protection (IRIPP), Agricultural Research, Education and Extension Organization (AREEO), Tehran, Iran

Abstract: A first annotated checklist of agarics and boletes in Iran is presented based on literature and new collections. A total number of 128 new DNA sequences, obtained from the nrDNA ITS region as well as the nrLSU, is provided. Based on vouchered specimens, 19 species are newly recorded from Iran, all provided with nrDNA data from basidiomata. Overall, 585 species (comprising 556 agarics and 29 bolete species) are recorded from Iran, representing 147 genera and 34 families. The order Agaricales encompasses 82% of the species. Twenty-eight species are excluded from the Iranian mycobiota. The Hyrcanian forests harbor 79% of the species, with Mazandaran being the most species-rich province in the country. The three largest genera are *Russula*, *Cortinarius*, and *Inocybe*. We also scrutinized the available DNA sequences of Iranian agarics and boletes deposited in public databases. It is shown that

64 species of agarics and boletes in Iran are from environmental sequences, and nine species have been retrieved as plant endophytes. In total, only 24% of Iranian species are shown to have at least one nrITS sequence in GenBank or UNITE. Our analyses reveal that 42% of records in Iran arise merely from abstracts presented at various conferences, most of which lack sufficient characterization and are suggested to be considered tentatively. General recommendations are given to avoid dissemination of low quality and ambiguous species records. This study fills in some of the gaps in our knowledge of agarics and boletes in Iran and provides a framework for biodiversity and phylogenetic studies.

Key words: Agaricomycetes, checklists, Hyrcanian forests, macrobasidiomycetes, mushrooms, Zagros forests

INTRODUCTION

Gilled fungi and boletes (often referred to as ‘mushrooms’) are among the most prevalent groups of macrofungi. Traditionally they are the best-studied fungi in many parts of the world probably on account of their potential value as a food source but also their conspicuous and often eye-catching fruitbodies. The number of described species worldwide now exceeds the ca. 14,500 species of Chang & Miles (2004) and Kirk et al. (2008). Gilled fungi, also commonly known as agarics, share a structural characteristic, *i.e.*, vertical plates, denoted as lamellae or more colloquially as gills (with varying shapes, sizes, thicknesses, distances from each other) which serve as spore-producing tissue on the undersurface of the cap and are a highly efficient way of increasing the surface area of the fertile part of the fungus. Boletes have tubes which are, in effect, simply rolled up gills, with some members of the Boletales having true gills *e.g.*, the genus *Phylloporus*. According to molecular evolutionary studies, the formation of gills has evolved several times and therefore, is considered to have been a characteristic worth preserving to assist in spore

dispersal and species survival (Hibbett et al. 1997).

Gilled fungi and boletes are very diverse, morphologically, chemically and ecologically. They range in size from a few millimeters in diameter (e.g., species of *Mycena*, *Marasmius* and *Coprinellus*), to more than a metre across the cap (*Macrocybe titans*, *Phlebopus marginatus*). Important variable characteristics include the presence or absence of a stipe, of veils, or veil remnants. The species exhibit numerous colors, odors and flavours. Chemically, some gilled taxa e.g., in the genera *Amanita*, *Galerina*, and *Cortinarius* contain a number of the most toxic natural compounds namely amatoxins, phallotoxins and orellanine; boletes do not have such lethal compounds although the genus *Rubroboletus* has a toxin (bolesatine) that causes severe gastrointestinal problems. In contrast, various species, e.g. *Agaricus campestris*, *Amanita caesarea*, and *Boletus edulis* are considered edible. There are other taxa of the genera *Psilocybe*, *Copelandia*, *Gymnopilus*, *Inocybe*, *Panaeolus*, *Pholiotina* and *Pluteus*, that produce hallucinogenic substances such as psilocybin and/or psilocin. Ecologically, as symbiotic partners involved in plant development (mycorrhizae), and as decomposers, with enzymes breaking down lignin and cellulose in woody and herbaceous debris, they are critical for carbon recycling and ecosystem functioning. Some species e.g. *Armillaria luteobubalina* and *Moniliophthora perniciosa* are pathogenic and/or parasitic and cause destruction of eucalypt forests and cacao crops respectively (Shearer & Tippet 1988, Meinhardt et al. 2008). The substrates also vary, as they grow on soil, wood, dung and litter. Many agarics and boletes also provide food and medicines for humans, and nutrition and habitat for other organisms. Biogeographically, they are widespread in temperate, equatorial, arctic and sub-antarctic ecosystems, possibly wherever a vegetation layer exists.

From a systematic viewpoint, the first comprehensive phylogenetic studies on agarics were published by Moncalvo et al. (2002) and Matheny et al. (2006). They were, and still are, the basis for the next studies of individual clades and groups of agarics worldwide. Concerning boletoid genera, the study by Wu et al. (2014) opened a broad field for defining many new genera. A ten-year phylogenetic overview of the Basidiomycota and related phyla in relation to DNA-based phylogeny was published by Zhao et al. (2017). An extensive study dealing with global patterns of mushroom evolution was recently published by Varga et al. (2019). According to the most recent account of a systematic outline of the Basidiomycota (He et al. 2019), the class Agaricomycetes currently contains 22 orders, of which agarics and boletes are distributed across the six orders Agaricales, Boletales, Cantharellales, Hymenochaetales, Polyporales, and Russulales.

Iran, with a wide elevational range, from 26 m b.s.l. along the southern coastline of the Caspian Sea, to 5,671 m a.s.l. at Damavand Mt. in Central Alborz, harbors diverse climates and habitats. Vast hot and dry deserts with a precipitation of less than 25 mm/yr in

central Iran, coincide with narrow sub-tropical humid regions at the northern parts of the country with precipitation exceeding 1,800 mm/yr. In Iran three macrobioclimates have been recognized, namely, mediterranean, tropical and temperate, largely correlating with the three biogeographical regions Irano-Turanian, Saharo-Sindian and Euro-Siberian, respectively (Djamali et al. 2011). Large parts of the country are characterized by continentality, with hot and dry summers, cold and harsh winters, and low precipitation, while forests are mainly confined to the northern and western borders (Zohary 1973, Djamali et al. 2012).

From a biodiversity viewpoint, Iran is at the crossroad of two global biodiversity hotspots, i.e. the Irano-Anatolian and the Caucasus (Mittermeier et al. 2005, Manafzadeh et al. 2017, Noroozi et al. 2019), covering the major mountain ranges of the country. Diverse topography and climate have resulted in the development of diverse flora and vegetation types. More than 8,000 vascular plant species are known from Iran with ca. 32% endemism (Noroozi et al. 2019). The number of woody plants in Iran is about 956 species (Mozaffarian 2005). Desert and semi-desert steppes, halophytes, montane grasslands, shrublands and woodlands, deciduous temperate forests, wetlands and alpine habitats are among the major vegetation types of the country (Noroozi 2020).

Hyrcanian forests, on the northern slopes of the Alborz mountain range, are at the southeastern reaches of the Caucasus biodiversity hotspot. Despite its small area (ca. 5% of the total area of Iran), the majority of the Iranian macromycetes come from the Hyrcanian region (e.g. Ghobad-Nejhad 2011, Ghobad-Nejhad & Hallenberg 2012). Broad-leaved dense forests have developed due to the high precipitation (ca. 700 to 2000 mm/yr) and mild climate of the region. These forests are known to belong to the northern hemisphere Pleistocene glacial refugia, and contain several Arcto-Tertiary elements, such as *Celtis australis*, *Parrotia persica*, *Pterocarya fraxinifolia* and *Zelkova carpinifolia* as well as evergreen plants (Zohary 1973, Frey et al. 1999, Akhiani et al. 2010, Gholizadeh et al. 2020). The Zagros forests in western Iran are comprised of xerophytic open woodlands of deciduous trees and shrubs mainly dominated by *Quercus* species and constitute less than 40% of the forest cover in Iran (Sagheb Talebi et al. 2014). Among the few coniferous forests native to Iran, *Juniperus excelsa* woodlands are noteworthy, sparsely covering the subalpine zone of the Irano-Turanian parts of the Iranian mountains, mostly distributed at 2000 to 3000 m a.s.l.

Macrofungi in Iran are far less studied compared to microfungi. Historically, mycology in Iran has been divided up into five distinct periods, with publications starting from 1860 (Ershad & Zare 2014). While the majority of studies are characterized by records on microascomycetes, the second period in Iranian mycology (1860–1941) also harbors publications containing some agarics and boletes. Interestingly, the oldest publication related to the fungi of Iran (Buhse

1860) contains eight species of agarics and boletes from the country, most of them later recorded in other publications (Table 1). The second oldest literature on Iranian fungi (Rabenhorst 1871) enumerates two species of this group. Later, publications by Petrak (1941, 1940, 1949) alone and jointly with the first Iranian mycologist E. Esfandiari (Petrak & Esfandiari 1941), appear, recording a few species of agarics and boletes from Iran (Table 1).

Most of the fungi of Iran recorded until 2008 (excluding lichenized fungi, clinical fungi, and some other taxa) have been listed in a book by Ershad (2009). In this book, a list of 3229 fungal species has been sorted in alphabetical order, but with no attempt at taxonomic classification. Therefore, to figure out the number of any fungal groups from this book, a full systematic categorization of the records is needed.

With regard to the number of macrobasidiomycetes in Iran, no clear figure is available, but up to now ca. 430 aphyllorphoroid species are known from the country, covering polypores (poroids), corticioids, hydroids, clavarioids and heterobasidiomycetes (Ghobad-Nejhad & Hallenberg 2012, Ghobad-Nejhad & Langer 2017); of these, 132 species are polypores (Ghobad-Nejhad & Bernicchia 2019). Statistics on agarics and boletes recorded from the country are largely lacking. Therefore, the aim of this study is to provide a first account on the diversity of gilled fungi and boletes in Iran, with annotations on their distribution, classification, and nrDNA.

MATERIALS AND METHODS

Species data

The study group includes species commonly known as gilled fungi (agarics) and boletes. Basically, the taxa such as *Schizophyllum commune* and *Daedalea/Daedaleopsis/Lenzites* which have some sort of 'gills' (but studied among aphyllorphoroid fungi), are not included. Data on agarics and boletes in this study were obtained from a thorough survey of scientific journal articles and books published up to the year 2020 and specimens collected by the first author. Moreover, sequences of Iranian material in GenBank and UNITE databases were incorporated after full identity check (see below). The basidiomata specimens were collected during 2000–2019 in different provinces of Iran. Samples were dehydrated using a mushroom drier or were air-dried. Macro- and micro-morphological characters of the specimens were studied under a binocular and a light microscope, using bright field or phase contrast optics. Microscopy routines generally followed Largent et al. (1977). Several identification keys (*e.g.*, Knudsen & Vesterholt 2008, Justo et al. 2011, Antonín et al. 2013, Zervakis et al. 2014, Mahdizadeh et al. 2016, Voto et al. 2019, *etc.*), and some of the literature in He et al. (2019) for specific genera were used. A full list of examined specimens is available in Suppl. Table. Vouchers were deposited at Iranian Cryptogamic

Herbarium (Index Herbariorum acronym ICH). Species current names and species authorities mostly follow MycoBank (www.mycobank.org), and Index Fungorum (www.indexfungorum.org). Recent or otherwise relevant taxonomic revisions and phylogenetic publications were also consulted. Records published in journals not approved by the Iranian Ministry of Science, Research and Technology ('black-listed journals') are not included here.

Molecular study

A clean portion of the spore-producing part of the dried basidiomata was taken for molecular study. For DNA extraction, PCR and sequencing, we generally followed the protocol by Bußkamp et al. (2020): from each basidioma, 1–2 mg of tissue was suspended in 100 µl TE buffer in a 1.5 ml tube. Immediately, for cell lysis, a microwave (600 W) was used twice for 1 min each, with a pause of 30 s followed by cooling the tubes to –20 °C for 20 minutes. The tubes were centrifuged at 10,000 rpm for 5 minutes. For PCR, 100 times diluted portion of the supernatant was used. The PCR primers for amplification of ITS1, 5.8S and ITS2 regions were ITS1F/ITS4 or ITS1/ITS4 (White et al. 1990, Gardes & Bruns 1993). For PCR, a 45 µl master mix (QIAGEN, Hilden, Germany) was used, adding 5 µl of extracted DNA. PCR was performed with initial denaturation at 94°C for 3 min, followed by 29 cycles of denaturation at 94°C for 30 s, annealing at 55°C for 45 s, and extension at 72°C for 60 s. Final elongation was performed at 72°C for 7 min. The D1–D4 domain of nuclear ribosomal large subunit (LSU; 28S) was amplified using primers LR0R and LR5 (Vilgalys & Hester 1990). The PCR thermal cycling for LSU differed from the ITS only by an increased cycle extension time (90 s per cycle). PCR products were visualized on a 1% agarose gel stained with GelRed fluorescence dye (Biotium, Hayward, CA, USA). Bands were cut out and cleaned with QIAquick PCR Purification Kit (QIAGEN, Hilden, Germany). Purified products were sequenced using Sanger sequencing method (Sanger et al. 1977). The obtained DNA sequences were edited using MEGA6 (Tamura et al. 2013) and DNA Sequence Assembler v4 (Heracle BioSoft 2013, www.DnaBaser.com), checked with BLASTn (Altschul et al. 1990) and UNITE (Nilsson et al. 2019), and submitted to GenBank.

We also searched through GenBank and UNITE databases extracting DNA sequences of agarics and boletes obtained from Iranian material, with a special focus on the ITS sequences. The sequences' associated metadata were carefully checked, and BLASTn searches were performed against sufficiently identified and reliable sequences in those databases. In UNITE, the Species Hypothesis (SH) with 0–1.5% threshold was accepted. Accession numbers with incorrect, ambiguous, or otherwise unverifiable identity were excluded. Selected ITS accession numbers were inserted in Table 1.

Table 1. Agarics and boletes in Iran. Species names in bold italics are current names, followed by synonyms in the corresponding literature. Records new to Iran are marked with an asterisk (*). The black circle (●) means that at least one DNA sequence exists from Iranian material; for these, representative ITS sequence(s) from GenBank or UNITE is presented. Accession numbers in bold were obtained in this study. Records with an exclamation mark (!) are recommended to be regarded as tentative only (see the text). Abbreviations: SH: Species Hypothesis; env.: environmental sequence.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
● <i>Agaricus arvensis</i> Schaeff.	Agaricales, Agaricaceae	Alborz, East Azerbaijan, Gilan, Golestan, Hamadan, Mazandaran, Tehran, West Azerbaijan, Zanjan	Saber 1994a, Fadavi et al. 2015, Mahdizadeh 2016, this study	MT535720
● <i>Agaricus bisporus</i> (J.E. Lange) Imbach	Agaricales, Agaricaceae	Ardabil, East Azerbaijan, Hormozgan, Khuzestan, Kurdistan, Lorestan, Markazi, Tehran, West Azerbaijan	Saber 1994a, Fadavi et al. 2015, Mahdizadeh 2016	MK287948
● <i>Agaricus bitorquis</i> (Quél.) Sacc.	Agaricales, Agaricaceae	Alborz, Chaharmahal and Bakhtiari, East Azerbaijan, Fars, Isfahan, Khuzestan, Kohgiluyeh and Boyer- Ahmad, Markazi, Razavi Khorasan, Tehran, West Azerbaijan	Watling & Gregory 1977, Zokaei 2001, Asef 2011b, Mahdizadeh 2016, this study	MT535709
! <i>Agaricus bresadolanus</i> Bohus	Agaricales, Agaricaceae	Golestan	Mahdizadeh 2016	
! <i>Agaricus brunneolus</i> (J.E. Lange) Pilát	Agaricales, Agaricaceae	Golestan	Mahdizadeh 2016	
<i>Agaricus campestris</i> L.	Agaricales, Agaricaceae	Ardabil, East Azerbaijan, Golestan, Mazandaran	Asef 2014, Mahdizadeh 2016	
! <i>Agaricus depauperatus</i> (F.H. Møller) Pilát	Agaricales, Agaricaceae	West Azerbaijan	Mahdizadeh 2016	
● <i>Agaricus devoniensis</i> P.D. Orton	Agaricales, Agaricaceae	Hormozgan, Kermanshah	Mahdizadeh 2016, Seidmohammadi et al. 2018b	MH173888
! <i>Agaricus gennadii</i> (Chatin & Boud.) P.D. Orton	Agaricales, Agaricaceae	West Azerbaijan	Mahdizadeh 2016	
● <i>Agaricus iodosmus</i> Heinem.	Agaricales, Agaricaceae	East Azerbaijan, Tehran	Mahdizadeh et al. 2016, this study	KT824784, MT535702
● <i>Agaricus iranicus</i> Mahdizadeh, Safaie, Goltapeh, L.A. Parra & Callac	Agaricales, Agaricaceae	Gilan	Mahdizadeh et al. 2017a	KY474556 (also several sequences available from different DNA regions)
! <i>Agaricus langei</i> (F.H. Møller) F.H. Møller	Agaricales, Agaricaceae	Golestan	Saber 1994a, Mahdizadeh 2016	
● <i>Agaricus litoralis</i> (Wakef. & A. Pearson) Pilát	Agaricales, Agaricaceae	Alborz, East Azerbaijan, Mazandaran, Semnan	Mahdizadeh 2016, this study	MT535711
<i>Agaricus biberi</i> Hlaváček				
● <i>Agaricus moelleri</i> Wasser	Agaricales, Agaricaceae	Gilan, Golestan, Mazandaran	Mahdizadeh et al. 2016	KT824787 (several more in GenBank)
● <i>Agaricus nevoi</i> Wasser	Agaricales, Agaricaceae	Bushehr, Fars, Hormozgan, Kermanshah, Khuzestan, Kohgiluyeh and Boyer-Ahmad	Mahdizadeh 2016, Seidmohammadi et al. 2018b	MH173866
● <i>Agaricus phaeolepidotus</i> (F.H. Møller) F.H. Møller	Agaricales, Agaricaceae	Mazandaran	Mahdizadeh et al. 2016	KT824790
! <i>Agaricus pseudolutosus</i> (G. Moreno, Esteve-Rav., Illana & Heykoop) G. Moreno, L.A. Parra, Esteve-Rav. & Heykoop	Agaricales, Agaricaceae	Gilan	Mahdizadeh 2016	
*● <i>Agaricus pseudopratisensis</i> (Bohus) Wasser	Agaricales, Agaricaceae	Tehran	this study	MT535735, MT535748
● <i>Agaricus subrufescens</i> Peck	Agaricales, Agaricaceae	Gilan	Mahdizadeh et al. 2017b	KT983412
● <i>Agaricus xanthodermus</i> Genev.	Agaricales, Agaricaceae	Gilan, Golestan	Mahdizadeh et al. 2016	KT824789

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
! <i>Agrocybe acericola</i> (Peck) Singer	Agaricales, Strophariaceae	Golestan, West Azerbaijan	Saber 1993f, Saber & Mehravaran 2004	MT535714 (more in Table 2)
● <i>Agrocybe dura</i> (Bolton) Singer	Agaricales, Strophariaceae	Gilan, Golestan, Kermanshah, Qazvin, Tehran, West Azerbaijan	Saber 1991b, Saber 1993f, Saber & Mehravaran 2004, Fadavi et al. 2013, this study	
<i>Pholiota vermiflua</i> (Peck) Sacc.	Strophariaceae	Kermanshah	Fadavi et al. 2013	
<i>Agrocybe ochracea</i> Nauta	Agaricales, Strophariaceae	Gilan	Saber 1995f	MT535701
! <i>Agrocybe paludosa</i> (J.E. Lange) Kühner & Romagn. ex Bon	Agaricales, Strophariaceae	Tehran	Saber 1993f, Saber & Zangeneh 2002	
! <i>Agrocybe pediades</i> (Fr.) Fayod	Agaricales, Strophariaceae	East Azerbaijan, Gilan, Golestan, Mazandaran, West Azerbaijan	Buhse 1860, Saber 1993f, Saber & Mehravaran 2004, Asef 2007b, this study	
<i>Agrocybe semiorbicularis</i> (Bull.) Fayod	Agaricales, Strophariaceae	Tehran	Saber 1993f	
● <i>Agrocybe praecox</i> (Pers.) Fayod	Agaricales, Strophariaceae	Gilan, Golestan, Mazandaran, West Azerbaijan	Saber 1993f	
<i>Agaricus togularis</i> Bull. ex Pers., <i>Agrocybe sphaleromorpha</i> (Bull. ex Pers.) Fayod, <i>Conocybe togularis</i> (Bull. ex Pers.) Kühner, <i>Pholiotina togularis</i> (Bull. ex Pers.) Fayod				
Note: some synonyms are tentative (unpublished research)				
! <i>Agrocybe pusiola</i> (Fr.) R. Heim	Agaricales, Strophariaceae	East Azerbaijan	Asef 2007b	
! <i>Agrocybe tabacina</i> (DC.) Konrad & Maubl.	Agaricales, Strophariaceae	Gilan, Kermanshah	Saber 1993f	
! <i>Agrocybe vervacti</i> (Fr.) Singer	Agaricales, Strophariaceae	Gilan	Saber 1995f	
! <i>Alnicola escharioides</i> (Fr.) Romagn. <i>Naucoria escharoides</i> (Fr.) P. Kumm.	Hymenogastraceae	Mazandaran	Saber & Zangeneh 2004	MT535691
! <i>Amanita atkinsoniana</i> Coker	Agaricales, Amanitaceae	Mazandaran	Bahram et al. 2006b, Asef & Etemad 2016	
<i>Amanita battarrae</i> (Boud.) Bon	Agaricales, Amanitaceae	Mazandaran	Bahram et al. 2006a, 2006b, Asef & Etemad 2016	
<i>Amanita caesarea</i> (Scop.) Pers.	Agaricales, Amanitaceae	Mazandaran	Bahram et al. 2006b, Asef & Etemad 2016	
<i>Amanita ceciliae</i> (Berk. & Broome) Bas	Agaricales, Amanitaceae	Mazandaran	Bahram et al. 2006b, Asef & Etemad 2016	
<i>Amanita crocea</i> (Qué.) Singer	Agaricales, Amanitaceae	Mazandaran	Saber 1995a	
<i>Amanita eliae</i> Qué.	Agaricales, Amanitaceae	Golestan, Mazandaran	Saber 1991a, Saber 1995a, Asef & Etemad 2016	
<i>Amanita excelsa</i> (Fr.) Bertill. <i>Amanita spissa</i> (Fr.) Bertill. <i>Amanita gemmata</i> (Fr.) Bertill.	Agaricales, Amanitaceae	Mazandaran	Saber 1991a, Saber 1995a	
● <i>Amanita lividopallescens</i> (Secr. ex Boud.) Kühner & Romagn. agg. Notes: regarded here as aggregate.	Agaricales, Amanitaceae	Ilam, Lorestan	Yousefshahi et al. 2020 (wrongly as <i>A. crocea</i>), this study	
● <i>Amanita pantherina</i> (DC.) Krombh.	Agaricales, Amanitaceae	East Azerbaijan, Golestan, 'Hyrcan', Mazandaran	Saber 1991a, Saber 1995a, Asef & Tavanaei 2004, Bahram et al. 2012, Asef & Etemad 2016	
<i>Amanita phalloides</i> (Fr.) Link	Agaricales, Amanitaceae	Gilan, Mazandaran, West Azerbaijan	Fallahyan 1973, Saber 1995a, Asef & Etemad 2016	
● <i>Amanita rubescens</i> Pers.	Agaricales, Amanitaceae	Gilan, 'Hyrcan'	Bahram et al. 2006b, 2012	
<i>Amanita strobiliformis</i> (Paulet ex Vittad.) Bertill.	Agaricales, Amanitaceae	Mazandaran	Saber & Zangeneh 2000	
<i>Amanita umbrinolutea</i> (Secr. ex Gillet) Bataille	Agaricales, Amanitaceae	Lorestan	Saber 1997a, Bahram et al. 2006b, Asef & Etemad 2016	
<i>Amanita vaginata</i> (Bull.) Lam. s.l. Notes: more species may be included under this name.	Agaricales, Amanitaceae	East Azerbaijan, Golestan, Mazandaran	Saber 1991a and 1995a, Asef & Tavanaei 2004, Asef & Etemad 2016	
<i>Amanita verna</i> (Bull.) Lam.	Agaricales, Amanitaceae	Gilan, Mazandaran	Saber 1991a, Saber 1995a	
<i>Ampulloclitocybe clavipes</i> (Pers.) Redhead, Lutzoni, Moncalvo & Vilgalys <i>Clitocybe clavipes</i> (Pers.) P. Kumm.	Agaricales, Hygrophoraceae	East Azerbaijan, Golestan, Mazandaran	Buhse 1860, Saber 2002a	FR852273 (env., SH2271424.08FU)

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Armillaria borealis</i> Marxm. & Korhonen	Agaricales, Physalacriaceae	Mazandaran	Asef & Mohammadi Goltapeh 2002, Dalili et al. 2008	
<i>Armillaria cepistipes</i> Velen.	Agaricales, Physalacriaceae	East Azerbaijan	Asef & Mohammadi Goltapeh 2002	
● <i>Armillaria gallica</i> Marxm. & Romagn.	Agaricales, Physalacriaceae	Alborz, East Azerbaijan, Golestan, Mazandaran	Asef et al. 2003, Dalili et al. 2008, Keča et al. 2014	KJ200954 (tef1), KJ200948 (LSU-IGC)
● <i>Armillaria mellea</i> (Vahl) P. Kumm. <i>Armillariella mellea</i> (Vahl) P. Karst., <i>Clitocybe mellea</i> (Vahl) Ricken	Agaricales, Physalacriaceae	Alborz, East Azerbaijan, Gilan, Golestan, Isfahan, Khuzestan, Markazi, Mazandaran, Qazvin, Razavi Khorasan, Semnan, West Azerbaijan	Sharif & Ershad 1966, Khabiri 1968, Saber 1973, Soleimani 1974 and 1976, Behboudi & Sabahi 1983, Jafarpour et al. 1983, Mohammadipour 2000, Razzaz-Hashemi & Zakeri 2000, Zokaei 2001, Asef & Mohammadi Goltapeh 2002, Asef & Tavanaei 2004, Coetzee et al. 2005, Amirahmadi et al. 2006, Asef 2007b, Taheri et al. 2008, Asef & Etemad 2016	AF163583, MG835859
! <i>Arrhenia griseopallida</i> (Desm.) Watling	Agaricales, Hygrophoraceae	Golestan	Saber 2002a	
<i>Omphalina griseopallida</i> (Desm.) Quél.				
<i>Asterophora lycoperdoides</i> (Bull.) Ditmar	Agaricales, Lyophyllaceae	Mazandaran	Mohammadi Goltapeh 2000a	
! <i>Atheniella flavoalba</i> (Fr.) Redhead, Moncalvo, Vilgalys, Desjardin & B.A. Perry	Agaricales, Mycenaceae	Gilan	Saber 1995h	
<i>Mycena flavoalba</i> (Fr.) Quél.				
! <i>Aureoboletus gentilis</i> (Quél.) Pouzar	Boletales, Boletaceae	Mazandaran	Bahram & Asef 2008a	
! <i>Baeospora myosura</i> (Fr.) Singer	Agaricales, Marasmiaceae	Mazandaran	Saber 1998	
<i>Battarrea stevenii</i> (Libosch.) Fr.	Agaricales, Agaricaceae	Golestan, Tehran	Saber 1986, Saber 2002b	
<i>Bolbitius reticulatus</i> (Pers.) Ricken	Agaricales, Bolbitiaceae	Golestan,	Saber 1993f	
<i>Bolbitius aleuriatus</i> (Fr.) Singer		Mazandaran		
! <i>Bolbitius tibubans</i> (Bull.) Fr.	Agaricales, Bolbitiaceae	Golestan	Saber 1993f	
! <i>Boletus aestivalis</i> (Paulet) Fr.	Boletales, Boletaceae	Golestan	Saber 1995d	
<i>Boletus edulis</i> Bull.	Boletales, Boletaceae	East Azerbaijan	Asef 2007b, 2008	
! <i>Butyriboletus appendiculatus</i> (Schaeff.) D. Arora & J. L. Frank, <i>Boletus appendiculatus</i> Schaeff.	Boletales, Boletaceae	Tehran	Zangeneh & Maivan 1998	
<i>Butyriboletus fechtneri</i> (Velen.) D. Arora & J.L. Frank	Boletales, Boletaceae	East Azerbaijan	Asef 2007b, 2008	
<i>Boletus fechtneri</i> Velen.				
● <i>Butyriboletus pseudoregius</i> (Heinr. Huber) D. Arora & J.L. Frank	Boletales, Boletaceae	'Hyrcaan'	Bahram et al. 2012	FR852279 (env., SH1933335.08FU)
! <i>Calocybe carnea</i> (Bull.) Donk	Agaricales, Lyophyllaceae	Tehran	Saber & Zangeneh 2004	
! <i>Calocybe chrysenteron</i> (Bull.) Singer	Agaricales, Lyophyllaceae	Gilan	Saber 2000d	
<i>Calocybe cerina</i> (Pers.) Donk				
! <i>Calocybe gambosa</i> (Fr.) Donk	Agaricales, Lyophyllaceae	Tehran	Saber 2000d	
! <i>Calocybe ionides</i> (Bull.) Donk	Agaricales, Lyophyllaceae	Gilan	Saber 2000d	
! <i>Calocybe persicolor</i> (Fr.) Singer	Agaricales, Lyophyllaceae	Mazandaran	Saber 2000d	
<i>Cantharellus alborufescens</i> (Malençon) Papetti & S. Alberti	Cantharellales, Hydnaceae	Golestan, Mazandaran	Parad et al. 2018	
<i>Cantharellus cibarius</i> Fr.	Cantharellales, Hydnaceae	Golestan	Ershad 1977, Saber 1987	
<i>Cantharellus ferruginascens</i> P.D. Orton	Cantharellales, Hydnaceae	Gilan, Golestan, Mazandaran	Parad et al. 2018	
<i>Chalciporus piperatus</i> (Bull.) Bataille	Boletales, Boletaceae	Golestan	Saber 1995d	
<i>Boletus piperatus</i> Bull.				

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
! <i>Chlorophyllum brunneum</i> (Farl. & Burt) Vellinga	Agaricales, Agaricaceae	?	Saber 1994a	
<i>Lepiota brunnea</i> Farl. & Burt				
<i>Chlorophyllum rhacodes</i> (Vittad.) Vellinga	Agaricales, Agaricaceae	East Azerbaijan	Saber 1994a, Mohammadi Goltapeh 2001	
<i>Macrolepiota rhacodes</i> (Vittad.) Singer				
<i>Clitocybe angustissima</i> (Lasch) P. Kumm.	Agaricales, incertae sedis	Golestan	Saber & Zangeneh 2004	
! <i>Clitocybe barbularum</i> (Romagn.) P.D. Orton	Agaricales, incertae sedis	Gilan	Saber 2002a	
! <i>Clitocybe diatreta</i> (Fr.) P. Kumm.	Agaricales, incertae sedis	West Azerbaijan	Saber & Mehravaran 2004	
! <i>Clitocybe metachroa</i> (Fr.) P. Kumm.	Agaricales, incertae sedis	Mazandaran	Saber 2002a	
<i>Clitocybe dicolor</i> (Pers.) Murrill	Agaricales, incertae sedis	Gilan, East Azerbaijan, Mazandaran	Saber 2002a, Asef 2007b	
! <i>Clitocybe nebularis</i> (Batsch) P. Kumm.	Agaricales, incertae sedis	Mazandaran	Saber 2002a	
! <i>Clitocybe phyllophila</i> (Pers.) P. Kumm.	Agaricales, incertae sedis	East Azerbaijan, Razavi Khorasan	Asef 2007b and 2009b	
<i>Clitocybe rufololulacea</i> Métrod ex Bon	Agaricales, incertae sedis	Gilan	Saber & Zangeneh 2004	
! <i>Clitocybe vibecina</i> (Fr.) Quéf.	Agaricales, incertae sedis			
<i>Clitocybe langei</i> Singer ex Hora,				
<i>Tephroclybe langei</i> (Singer) Raithelh.				
! <i>Clitopaxillus alexandri</i> (Gillet) G. Moreno, Vizzini, Consiglio & P. Alvarado	Agaricales, incertae sedis	Gilan	Saber 2002a	
<i>Clitocybe alexandri</i> (Gillet) Gillet				
<i>Clitopilus prunulus</i> (Scop.) P. Kumm.	Agaricales, Entolomataceae	Gilan, Golestan, Mazandaran	Saber 1993d and 1997a	
<i>Clitopilus orcellus</i> (Bull. ex Pers.) P. Kumm.				
<i>Clitopilus scyphoides</i> (Fr.) Singer	Agaricales, Entolomataceae	Golestan	Saber 1995e and 1997a	
<i>Clitopilus cretatus</i> (Berk. & Broome) Quéf., <i>Clitopilus intermedius</i> Romagn., <i>Clitopilus scyphoides</i> var. <i>intermedius</i> (Romagn.) Noordel.				
! <i>Collybia tuberosa</i> (Bull.) P. Kumm.	Agaricales, incertae sedis	Gilan	Saber 1998	
<i>Conocybe albipes</i> (G.H. Otth) Hauskn.	Agaricales, Bolbitiaceae	Alborz, Golestan, Kermanshah, Razavi Khorasan, Tehran	Saber 1993f, Zokaei 2001, Fadavi et al. 2013	
<i>Conocybe lactea</i> (J.E. Lange) Métrod				
*• <i>Conocybe apala</i> (Fr.) Arnolds	Agaricales, Bolbitiaceae	Tehran	this study	MT535728
<i>Conocybe dunensis</i> T.J. Wallace	Agaricales, Bolbitiaceae	Kermanshah	Fadavi et al. 2013	
<i>Conocybe juniana</i> (Velen.) Hauskn. & Svrček	Agaricales, Bolbitiaceae	Golestan	Watling & Gregory 1977	
<i>Conocybe magnicapitata</i> P.D. Orton				
<i>Conocybe leucopus</i> Kühner ex Kühner & Watling	Agaricales, Bolbitiaceae	Hamadan	Jadidian et al. 2015	
! <i>Conocybe macrocephala</i> Kühner & Watling	Agaricales, Bolbitiaceae	Mazandaran	Saber 1993f	
! <i>Conocybe microspora</i> (Velen.) Dennis	Agaricales, Bolbitiaceae	Mazandaran	Saber 1995f	
<i>Conocybe brunneola</i> Kühner ex Kühner & Watling				
! <i>Conocybe ochracea</i> Kühner ex Singer	Agaricales, Bolbitiaceae	Golestan, Tehran	Saber 1993f	
! <i>Conocybe pilosella</i> (Pers.) Kühner	Agaricales, Bolbitiaceae	Mazandaran	Saber 1995f	
! <i>Conocybe rickenii</i> (Jul. Schäff.) Kühner	Agaricales, Bolbitiaceae	Gilan, Tehran	Saber 1993f	
! <i>Conocybe subovalis</i> Kühner & Watling	Agaricales, Bolbitiaceae	Alborz	Saber 1993f	
! <i>Conocybe tenera</i> (Schaeff.) Fayod	Agaricales, Bolbitiaceae	Sistan and Baluchestan, Tehran	Saber 1993f, Saber & Esmaili Taheri 2004	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
!Contumyces rosellus (M.M. Moser) Redhead, Moncalvo, Vilgalys & Lutzoni <i>Marasmiellus rosellus</i> (M.M. Moser) Kuyper & Noordel., <i>Omphalina rosella</i> (M.M. Moser) M.M. Moser ex Redhead, Ammirati & Norvell	Hymenochaetales, Rickenellaceae	Mazandaran	Saber 2002a	
Coprinellus angulatus (Peck) Redhead <i>Coprinus angulatus</i> Peck	Agaricales, Psathyrellaceae	Fars, Tehran	Mohammadi Goltapeh 2003, Saber & Esmaeili Taheri 2004	
•Coprinellus disseminatus (Pers.) J.E. Lange <i>Coprinus disseminatus</i> (Pers.) Gray	Agaricales, Psathyrellaceae	Alborz, Isfahan, Mazandaran, Razavi Khorasan, Sistan and Baluchestan, Tehran	Saber 1994b, Mohammadi Goltapeh 2000b and 2001, Zokaei 2001, Saber & Esmaeili Taheri 2002 and 2004, Asef & Etemad 2016, this study	MK050584
!Coprinellus domesticus (Bolton) Vilgalys, Hopple & Jacq. Johnson <i>Coprinus domesticus</i> (Bolton) Gray	Agaricales, Psathyrellaceae	?	Saber 1994b	
Coprinellus flocculosus (DC.) Vilgalys, Hopple & Jacq. Johnson <i>Coprinus flocculosus</i> (DC.) Fr.	Agaricales, Psathyrellaceae	Tehran	Saber 1994b, Mohammadi Goltapeh 2000b and 2001	
!Coprinellus impatiens (Fr.) J.E. Lange <i>Coprinus impatiens</i> (Fr.) Quél.	Agaricales, Psathyrellaceae	?	Saber 1994b	
•Coprinellus micaceus (Bull.) Vilgalys, Hopple & Jacq. Johnson <i>Coprinus micaceus</i> (Bull.) Fr.	Agaricales, Psathyrellaceae	Alborz, Ilam, Isfahan, Kohgiluyeh and Boyer-Ahmad, Mazandaran, Razavi Khorasan, Tehran, West Azerbaijan	Petrak 1940, Petrak & Esfandiari 1941, Esfandiari 1946, Khabiri 1968, Soleimani 1974 and 1976, Zokaei 2001, Saber & Esmaeili Taheri 2002, Saber & Mehravaran 2004, Asef & Etemad 2016, this study	MT535694
•Coprinellus radians (Desm.) Vilgalys, Hopple & Jacq. Johnson	Agaricales, Psathyrellaceae	Mazandaran	Ziaie Juybari et al. 2019	KU375662 (as endophyte)
!Coprinellus silvaticus (Peck) Gminder <i>Coprinellus tardus</i> (P. Karst.) P. Karst., <i>Coprinus silvaticus</i> Peck	Agaricales, Psathyrellaceae	?	Saber 1994b	
Coprinellus subimpatiens (M. Lange & A.H. Sm.) Redhead, Vilgalys & Moncalvo <i>Coprinus subimpatiens</i> M. Lange & A.H. Sm.	Agaricales, Psathyrellaceae	Alborz	Mohammadi Goltapeh 2003	
!Coprinellus truncorum (Scop.) Redhead, Vilgalys & Moncalvo	Agaricales, Psathyrellaceae	East Azerbaijan	Asef 2007b	
!Coprinellus xanthothrix (Romagn.) Vilgalys, Hopple & Jacq. Johnson <i>Coprinus xanthothrix</i> Romagn.	Agaricales, Psathyrellaceae	?	Saber 1994b	
•Coprinopsis atramentaria (Bull.) Redhead, Vilgalys & Moncalvo <i>Coprinus atramentarius</i> (Bull.) Fr.	Agaricales, Psathyrellaceae	Alborz, Gilan, Isfahan, Kermanshah, Mazandaran, Razavi Khorasan, Tehran, West Azerbaijan	Khabiri 1968, Soleimani 1974 and 1976, Saber 1994b, Zokaei 2001, Saber & Esmaeili Taheri 2002, 2004, Saber & Mehravaran 2004, GenBank direct submission, this study	MH259864
Coprinopsis brunneofibrillosa (Dennis) Redhead, Vilgalys & Moncalvo <i>Coprinus brunneofibrillosus</i> Dennis	Agaricales, Psathyrellaceae	Mazandaran, Tehran	Mohammadi Goltapeh 2000b and 2003	
•Coprinopsis cinerea (Schaeff.) Redhead, Vilgalys & Moncalvo <i>Coprinus cinereus</i> (Schaeff.) Gray, <i>Coprinus fimetarius</i> sensu auct. brit.	Agaricales, Psathyrellaceae	Alborz, Mazandaran, Tehran	Khabiri 1968, Mohammadi Goltapeh 2003, GenBank direct submission	MF161131 (as endophyte)
Coprinopsis ephemeroides (DC.) G. Moreno <i>Coprinus ephemeroides</i> (DC.) Fr.	Agaricales, Psathyrellaceae	Alborz	Mohammadi Goltapeh 2003	
!Coprinopsis friesii (Quél.) P. Karst. <i>Coprinus friesii</i> Quél.	Agaricales, Psathyrellaceae	?	Saber 1994b	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
!Coprinopsis gonophylla (Quél.) Redhead, Vilgalys & Moncalvo <i>Coprinus gonophyllus</i> Quél.	Agaricales, Psathyrellaceae	?	Saber 1994b	
Coprinopsis lagopides (P. Karst.) Redhead, Vilgalys & Moncalvo <i>Coprinus lagopides</i> P. Karst.	Agaricales, Psathyrellaceae	Tehran	Mohammadi Goltapeh 2003	
Coprinopsis lagopus (Fr.) Redhead, Vilgalys & Moncalvo <i>Coprinus lagopus</i> (Fr.) Fr.	Agaricales, Psathyrellaceae	Alborz, Mazandaran	Saber 1994b, Mohammadi Goltapeh 2003	
Coprinopsis macrocephala (Berk.) Redhead, Vilgalys & Moncalvo <i>Coprinus macrocephalus</i> (Berk.) Berk.	Agaricales, Psathyrellaceae	Tehran	Mohammadi Goltapeh 2003	
!Coprinopsis marcescibilis (Britzelm.) Örstadius & E. Larss. <i>Psathyrella marcescibilis</i> (Britzelm.) Singer	Agaricales, Psathyrellaceae	?	Saber 1994b	
!Coprinopsis martinii (P.D. Orton) Redhead, Vilgalys & Moncalvo <i>Coprinus martinii</i> P.D. Orton	Agaricales, Psathyrellaceae	Isfahan	Saber & Esmaeili Taheri 2004	
Coprinopsis nivea (Pers.) Redhead, Vilgalys & Moncalvo <i>Coprinus niveus</i> (Pers.) Fr.	Agaricales, Psathyrellaceae	Alborz, East Azerbaijan	Saber 1994a, Mohammadi Goltapeh 2003, Asef 2007b	
Coprinopsis patouillardii (Quél.) Gminder <i>Coprinus patouillardii</i> Quél.	Agaricales, Psathyrellaceae	Tehran	Mohammadi Goltapeh 2003	
Coprinopsis picacea (Bull.) Redhead, Vilgalys & Moncalvo <i>Coprinus picaceus</i> (Bull.) Gray	Agaricales, Psathyrellaceae	Alborz, East Azerbaijan, Lorestan, Razavi Khorasan	Saber 1994b, Zokaei 2001, Mohammadi Goltapeh 2003, Saber & Esmaeili Taheri 2004	
•Coprinopsis sclerotiger (Watling) Redhead, Vilgalys & Moncalvo	Agaricales, Psathyrellaceae	?	GenBank direct submission	MF161132 (as endophyte)
Coprinopsis scobicola (P.D. Orton) Redhead, Vilgalys & Moncalvo <i>Coprinus scobicola</i> P.D. Orton	Agaricales, Psathyrellaceae	Tehran	Mohammadi Goltapeh 2001	
•Coprinopsis urticicola (Berk. & Broome) Redhead, Vilgalys & Moncalvo	Agaricales, Psathyrellaceae	Kermanshah, Mazandaran	Asef et al. 2015, Gholami et al. 2019	MH300615 (as endophyte)
Coprinus comatus (O.F. Müll.) Pers.	Agaricales, Agaricaceae	Kermanshah, Mazandaran, Razavi Khorasan, Tehran	Khabiri 1968, Fallahyan 1973, Mohammadi Goltapeh 2000b and 2001, Zokaei 2001, Fadavi et al. 2015, Asef & Etemad 2016, this study	
Coprinus sterquilinus (Fr.) Fr.	Agaricales, Agaricaceae	Kermanshah	Saber & Dadkhipour 2000, Fadavi et al. 2015	
•Cortinarius bivelus (Fr.) Fr.	Agaricales, Cortinariaceae	‘Hyrcan’	Bahram et al. 2012	FR852016 (env., SH2224383.08FU)
•Cortinarius caesiocortinatus Jul. Schäff.	Agaricales, Cortinariaceae	‘Hyrcan’	Bahram et al. 2012	FR852020 (env., SH1504045.08FU)
•Cortinarius casimirii (Velen.) Huijsman	Agaricales, Cortinariaceae	‘Hyrcan’	Bahram et al. 2012	FR851999 (env., SH1917131.08FU)
Cortinarius causticus Fr.	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007a, b	
•Cortinarius cinnabarinus Fr.	Agaricales, Cortinariaceae	‘Hyrcan’	Bahram et al. 2012	FR852005 (env., SH1710033.08FU)
!Cortinarius cinnamomeus (L.) Gray	Agaricales, Cortinariaceae	Gilan	Saber 1994c, Saber 2000c	
•Cortinarius cotoneus Fr.	Agaricales, Cortinariaceae	‘Hyrcan’	Bahram et al. 2012	FR852015 (env., SH1855917.08FU)
•Cortinarius decipiens Fr.	Agaricales, Cortinariaceae	Mazandaran	Saber & Zangeneh 2004, Bahram et al. 2013	HE687043 (env., SH1917130.08FU)
•Cortinarius diasemospermus Lamoure	Agaricales, Cortinariaceae	Mazandaran?	Bahram et al. 2013	HE687042 (env., SH2224452.08FU)
Cortinarius erumpens Rob. Henry	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007a and 2007b	
•Cortinarius ferrugineovelatus Kytöv., Liimat. & Niskanen	Agaricales, Cortinariaceae	‘Hyrcan’	Bahram et al. 2012	FR852002 (env., SH2224500.08FU)
Cortinarius fluryi (M.M. Moser) M.M. Moser	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007b and 2009a	
*•Cortinarius hildegardiae Schmidt-Stohn, Brandrud & Dima	Agaricales, Cortinariaceae	Golestan	this study	MT535704

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
● <i>Cortinarius hinnuleus</i> Fr.	Agaricales, Cortinariaceae	'Hyrcan'	Bahram et al. 2012	FR851998 (env., SH1917246.08FU) FR852022 (env., SH1855756.08FU) FR851993 (env., SH1855819.08FU)
● <i>Cortinarius infractus</i> (Pers.) Fr.	Agaricales, Cortinariaceae	'Hyrcan'	Bahram et al. 2012	
● <i>Cortinarius olivaceofuscus</i> Kühner	Agaricales, Cortinariaceae	'Hyrcan'	Bahram et al. 2012	
<i>Cortinarius paracephalix</i> Bohus	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007b and 2009a	
● <i>Cortinarius parvannulatus</i> Kühner	Agaricales, Cortinariaceae	Mazandaran?	Bahram et al. 2013	HE687041 (env., SH1709965.08FU) MT535741
*● <i>Cortinarius persoonianus</i> Bidaud	Agaricales, Cortinariaceae	Golestan	this study	
<i>Cortinarius pluviorum</i> Jul. Schäff. ex M.M. Moser	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007a and 2007b	
● <i>Cortinarius uraceonemoralis</i> Niskanen, Liimat., Dima, Kytöv., Bojantchev & H. Lindstr.	Agaricales, Cortinariaceae	'Hyrcan'	Bahram et al. 2012	
! <i>Cortinarius valgius</i> Fr.	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007b	HE687034 (env., SH1917268.08FU)
● <i>Cortinarius vernus</i> H. Lindstr. & Melot	Agaricales, Cortinariaceae	Mazandaran?	Bahram et al. 2013	
<i>Cortinarius vespertinus</i> (Fr.) Fr.	Agaricales, Cortinariaceae	East Azerbaijan	Asef 2007b and 2009a	
<i>Cortinarius vibratilis</i> (Fr.) Fr.	Agaricales, Cortinariaceae	Mazandaran	Bahram & Asef 2008a, Asef & Etemad 2016	
<i>Cortinarius violaceus</i> (L.) Gray	Agaricales, Cortinariaceae	Mazandaran	Khabiri 1968, Saber 1994c	Saber 1989b
<i>Craterellus cinereus</i> (Pers.: Fr.) Maire	Cantharellales, Hydnaceae	Gilan, Mazandaran	Saber 1989b	
<i>Craterellus cornucopioides</i> (L.) Pers.	Cantharellales, Hydnaceae	Gilan, Mazandaran	Khabiri 1968, Saber 1987	
<i>Pleurotus cornucopioides</i> (L.) Gillet	Cantharellales, Hydnaceae	'forests of northern Iran'	Fallahyan 1973	
<i>Craterellus tubaeformis</i> (Fr.) Qué.	Agaricales, Inocybaceae	Gilan, Golestan, Mazandaran	Saber 1990, Asef & Etemad 2016	Saber 1990, Saber 1997a, Saber & Zangeneh 2002, Saber & Esmaili Taheri 2004, Asef & Etemad 2016
<i>Crepidotus applanatus</i> (Pers.) P. Kumm.	Agaricales, Inocybaceae	Gilan, Golestan, Mazandaran	Saber 1990, Asef & Etemad 2016	
<i>Crepidotus casparyi</i> Velen.	Agaricales, Inocybaceae	Gilan, Golestan, Mazandaran	Saber 1990, Asef & Etemad 2016	
<i>Crepidotus amygdalosporus</i> Kühner, <i>Crepidotus inhonestus</i> P. Karst. [sensu Orton, Pegler & Young, and Nordstein (non s. P. Karst.)], <i>Crepidotus lundellii</i> Pilát	Agaricales, Inocybaceae	Gilan, Golestan, Mazandaran	Saber 1990, Asef & Etemad 2016	
<i>Crepidotus cesatii</i> (Rabenh.) Sacc.	Agaricales, Inocybaceae	East Azerbaijan, Mazandaran	Watling & Sweeney 1974, Asef 2007b	MT535745
<i>Crepidotus crocophyllus</i> (Berk.) Sacc.	Agaricales, Inocybaceae	Golestan, Mazandaran	Saber 1997a, Asef & Etemad 2016	
<i>Crepidotus mollis</i> (Schaeff.) Staude	Agaricales, Inocybaceae	Gilan, Golestan, Mazandaran	Saber 1990	
*● <i>Crepidotus subverrucisporus</i> Pilát	Agaricales, Inocybaceae	East Azerbaijan	this study	
! <i>Crinipellis scabellia</i> (Alb. & Schwein.) Murrill	Agaricales, Marasmiaceae	Golestan	Saber 1995g	MT535688
<i>Crinipellis stipitaria</i> (Fr.) Pat.	Agaricales, Hygrophoraceae	Mazandaran	this study	
*● <i>Cuphophyllus virgineus</i> (Wulfen) Kovalenko	Agaricales, Hygrophoraceae	Mazandaran	this study	
<i>Hygrocybe virginea</i> (Wulfen) P.D. Orton & Watling	Agaricales, Hygrophoraceae	Mazandaran	this study	
<i>Cyanoboletus pulverulentus</i> (Opat.) Gelardi, Vizzini & Simonini	Boletales, Boletaceae	East Azerbaijan, Gilan	Saber 1995d, Asef 2007b and 2008	MT573399
<i>Boletus pulverulentus</i> Opat.	Boletales, Boletaceae	East Azerbaijan, Gilan	Saber 1995d, Asef 2007b and 2008	
● <i>Cyclocybe cylindracea</i> (DC.) Vizzini & Angelini	Agaricales, Tubariaceae	Gilan, Golestan, Mazandaran, Razavi Khorasan	Khabiri 1968, Soleimani 1976, Saber 1993f, Zokaei 2001, Asef & Etemad 2016, GenBank direct submission	
<i>Agrocybe cylindracea</i> (DC.) Maire, <i>Pholiota aegerita</i> (V. Brig.) Qué.	Agaricales, Tubariaceae	Gilan, Golestan, Mazandaran, Razavi Khorasan	Khabiri 1968, Soleimani 1976, Saber 1993f, Zokaei 2001, Asef & Etemad 2016, GenBank direct submission	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Cystoderma aureum</i> (Matt.) Kühner & Romagn. <i>Phaeolepiota aurea</i> (Matt.) Maire ex Konrad & Maubl.	Agaricales, incertae sedis	Golestan, Mazandaran	Saber 1994a, Asef & Etemad 2016	
● <i>Deconica crobula</i> (Fr.) Romagn. <i>Psilocybe crobula</i> (Fr.) Singer ! <i>Delicatula integrella</i> (Pers.) Fayod	Agaricales, Strophariaceae Agaricales, incertae sedis	East Azerbaijan, Razavi Khorasan Mazandaran	Saber 1991a, Zokaei 2001, this study Saber 1995h	MT535747
! <i>Dermoloma cuneifolium</i> (Fr.) Singer ex Bon <i>Dermoloma atrocinerum</i> (Pers.) Herink, <i>Tricholoma atrocinerum</i> (Pers.) Quél.	Agaricales, incertae sedis	Golestan	Saber 2000d	
● <i>Echinoderma asperum</i> (Pers.) Bon <i>Amanita aspera</i> (Pers.) Pers., <i>Lepiota aspera</i> (Pers.) Quél., <i>Lepiota acutesquamosa</i> (Weinm.) P. Kumm.	Agaricales, Agaricaceae	Golestan, Mazandaran	Saber 1994a, Saber & Zangeneh 2002, Bahrām et al. 2006b, Asef & Etemad 2016	
! <i>Entoloma clypeatum</i> (L.) P. Kumm.	Agaricales, Entolomataceae	Mazandaran	Saber 1993d	
● <i>Entoloma griseoluridum</i> (Kühner) M.M. Moser	Agaricales, Entolomataceae	East Azerbaijan	Asef 2007b, Asef & Muradov 2014	
● <i>Entoloma griseorubellum</i> (Lasch) Kalamees & Urbonas	Agaricales, Entolomataceae	Kermanshah	Fadavi et al. 2013	
! <i>Entoloma hirtipes</i> (Schumach.) M.M. Moser	Agaricales, Entolomataceae	Gilan	Saber 2000c	
● <i>Entoloma incanum</i> (Fr.) Hesler	Agaricales, Entolomataceae	Golestan, Razavi Khorasan	Zokaei 2001, Saber & Zangeneh 2002	
! <i>Entoloma majaloides</i> P.D. Orton	Agaricales, Entolomataceae	Golestan	Saber & Zangeneh 2002	
! <i>Entoloma mammosum</i> (L.) Hesler	Agaricales, Entolomataceae	Golestan	Saber 1993d	
● <i>Entoloma niphoides</i> Noordel.	Agaricales, Entolomataceae	East Azerbaijan	Asef & Muradov 2014	
! <i>Entoloma rhodopolium</i> (Fr.) P. Kumm.	Agaricales, Entolomataceae	Gilan, Mazandaran	Saber 1993d	
! <i>Entoloma sericellum</i> (Fr.) P. Kumm.	Agaricales, Entolomataceae	Gilan	Saber 1993d	
● <i>Entoloma sinuatum</i> (Bull. ex Pers.) P. Kumm.	Agaricales, Entolomataceae	Golestan, Mazandaran	Saber 1995f, Asef & Etemad 2016	
● <i>Entoloma subcollariatum</i> (Kühner) Bon	Agaricales, Entolomataceae	?	GenBank direct submission	MH453494
! <i>Entoloma vernum</i> S. Lundell	Agaricales, Entolomataceae	Ardabil	Saber & Zangeneh 2002	
! <i>Flammula alnicola</i> (Fr.) P. Kumm.	Agaricales, Hymenogastraceae	?	Saber 1991b	
<i>Pholiota alnicola</i> (Fr.) Singer				
! <i>Flammulaster erinaceellus</i> (Peck) Watling	Agaricales, Inocybaceae	Mazandaran	Saber 1993a	
● <i>Flammulaster ferrugineus</i> (Maire) Watling	Agaricales, Inocybaceae	Golestan	Watling & Gregory 1977	
! <i>Flammulaster gracilis</i> (Quél.) Watling	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1993a	
! <i>Flammulaster granulosus</i> (J.E. Lange) Watling	Agaricales, Inocybaceae	Tehran	Saber 1995f	
● <i>Flammulina velutipes</i> (Curtis) Singer	Agaricales, Physalacriaceae	Alborz, East Azerbaijan, Gilan, Isfahan, Mazandaran, Razavi Khorasan, Tehran	Soleimani 1974 and 1976, Saber 1998, Zokaei 2001, Asef 2007b, Asef & Etemad 2016, this study	MT535715
<i>Collybia velutipes</i> (Curtis) P. Kumm., <i>Collybia velutipes</i> var. <i>lactea</i> (Quél.) Rea, <i>Flammulina</i> <i>velutipes</i> var. <i>lactea</i> (Quél.) Bas				
! <i>Galerina hypnorum</i> (Schrank) Kühner	Agaricales, Hymenogastraceae	?	Saber 1994c	
● <i>Galerina marginata</i> (Batsch) Kühner	Agaricales, Hymenogastraceae	Golestan, Mazandaran	Watling & Sweeney 1974, Saber 1994c	
<i>Galerina unicolor</i> (Vahl) Singer				
! <i>Galerina mniophila</i> (Lasch) Kühner	Agaricales, Hymenogastraceae	?	Saber 1994c	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
! <i>Galerina pumila</i> (Pers.) M. Lange	Agaricales,	?	Saber 1994c	
<i>Galerina mycenopsis</i> (Fr.) Kühner	Hymenogastraceae			
! <i>Galerina sphagnorum</i> (Pers.) Kühner	Agaricales, Hymenogastraceae	?	Saber 1994c	
! <i>Gymnopilus penetrans</i> (Fr.) Murrill	Agaricales, Strophariaceae	?	Saber 1994c	
● <i>Gymnopilus spectabilis</i> (Weinm.) A.H. Sm.	Agaricales, Strophariaceae	Golestan	Saber 1994c, Vahidi et al. 2006, this study	MT535703
<i>Gymnopilus junonius</i> (Fr.) P.D. Orton				
! <i>Gymnopus androsaceus</i> (L.) J.L. Mata & R.H. Petersen	Agaricales, Omphalotaceae	Gilan, Golestan, Mazandaran	Saber 1995g	
<i>Marasmius androsaceus</i> (L.) Fr.				
*● <i>Gymnopus aquosus</i> (Bull.) Antonín & Noordel.	Agaricales, Omphalotaceae	Mazandaran	this study	MT535700, MT535699
! <i>Gymnopus brassicolens</i> (Romagn.) Antonín & Noordel.	Agaricales, Omphalotaceae	Gilan	Saber 1995g	
<i>Micromphale brassicolens</i> (Romagn.) P.D. Orton				
<i>Gymnopus dryophilus</i> (Bull.) Murrill	Agaricales, Omphalotaceae	Gilan, Golestan, Mazandaran	Buhse 1860, Saber 1998	
<i>Collybia dryophila</i> (Bull.) P. Kumm.				
! <i>Gymnopus erythropus</i> (Pers.) Antonín, Halling & Noordel.	Agaricales, Omphalotaceae	East Azerbaijan, Gilan, Mazandaran, Tehran	Saber 1998, Saber & Zangeneh 2004, Asef 2007b	
<i>Collybia acervata</i> sensu auct., <i>Collybia erythropus</i> (Pers.) P. Kumm.				
! <i>Gymnopus foetidus</i> (Sowerby) J.L. Mata & R.H. Petersen	Agaricales, Omphalotaceae	East Azerbaijan, Gilan, Mazandaran	Saber 1995g, Asef 2007b	
<i>Micromphale foetidum</i> (Sowerby) Singer				
<i>Gymnopus fusipes</i> (Bull.) Gray	Agaricales,	Alborz, Gilan	Saber 1998, Soleimani 1974 and 1976	
<i>Collybia fusipes</i> (Bull.) Quél.	Omphalotaceae			
*● <i>Gymnopus hybridus</i> (Kühner & Romagn.) Antonín & Noordel.	Agaricales, Omphalotaceae	Ilam	this study	MT535705
! <i>Gymnopus inodorus</i> (Pat.) Antonín & Noordel.	Agaricales, Omphalotaceae	Gilan, Golestan, Mazandaran	Saber 1995g	
<i>Micromphale inodorum</i> (Pat.) Svrček				
! <i>Gymnopus terginus</i> (Fr.) Antonín & Noordel.	Agaricales, Omphalotaceae	Gilan, Mazandaran	Saber 1995g	
<i>Marasmius terginus</i> (Fr.) Fr.				
*● <i>Gyroporus castaneus</i> (Bull.) Quél.	Boletales, Gyroporaceae	Golestan	this study	MT535725
! <i>Hebeloma birrus</i> (Fr.) Gillet	Agaricales, Hymenogastraceae	?	Saber 1994c	
! <i>Hebeloma crustuliniforme</i> (Bull.) Quél.	Agaricales, Hymenogastraceae	?	Saber 1994c	
! <i>Hebeloma hiemale</i> Bres.	Agaricales, Hymenogastraceae	East Azerbaijan	Asef 2007b	
<i>Hebeloma oculatum</i> Bruchet	Hymenogastraceae			
● <i>Hebeloma incarnatum</i> A.H. Sm.	Agaricales, Hymenogastraceae	‘Hyrcan’	Bahram et al. 2012	FR852303 (env., SH2290416.08FU)
! <i>Hebeloma mesophaeum</i> (Pers.) Quél.	Agaricales, Hymenogastraceae	?	Saber 1994c	
● <i>Hebeloma sinapizans</i> (Paulet) Gillet	Agaricales, Hymenogastraceae	?	Saber 1994c	KX266254 (original submission named wrongly)
! <i>Hemileccinum impolitum</i> (Fr.) Šutara	Boletales, Boletaceae	Kohgiluyeh and Boyer- Ahmad	Saber 1995d	
<i>Boletus impolitus</i> Fr., <i>Xerocomus</i> <i>impolitus</i> (Fr.) Quél.				
! <i>Hemimycena cucullata</i> (Pers.) Singer	Agaricales, incertae sedis	Mazandaran	Saber 1995h	
! <i>Hodophilus hymenocephalus</i> (A.H. Sm. & Hesler) Birkebak & Adamčík	Agaricales, Clavariaceae	East Azerbaijan	Asef 2007b	
<i>Camarophylloopsis hymenocephala</i> (A.H. Sm. & Hesler) Arnolds				

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Hohenbuehelia atrocoerulea</i> (Fr.) Singer	Agaricales, Pleurotaceae	Gilan	Saber 1990	
<i>Hohenbuehelia auriscalpium</i> (Maire) Singer	Agaricales, Pleurotaceae	Golestan, Mazandaran	Shahtahmasebi et al. 2018	
<i>Hohenbuehelia petaloides</i> (Bull.) Schulzer	Agaricales, Pleurotaceae	Gilan, Mazandaran	Saber 1990	
<i>Hohenbuehelia geogenia</i> (DC. ex Fr.) Singer				
<i>!Homophron spadiceum</i> (P. Kumm.) Örstadius & E. Larss. <i>Psathyrella sarcocephala</i> (Fr.) Singer	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>!Hydropus marginellus</i> (Pers.) Singer	Agaricales, Marasmiaceae	Mazandaran	Saber 2002a	
<i>!Hygrocybe acutoconica</i> (Clem.) Singer	Agaricales, Hygrophoraceae	Mazandaran	Saber 1995f	
<i>Hygrocybe persistens</i> (Britzelm.) Singer				
<i>!Hygrocybe chlorophana</i> (Fr.) Wünsche	Agaricales, Hygrophoraceae	Mazandaran	Saber 1993d	
<i>Hygrophoropsis aurantiaca</i> (Wulfen) Maire	Boletales, Hygrophoropsidaceae	Gilan, Mazandaran	Khabiri 1968, Saber 1993d	
<i>Cantharellus aurantiacus</i> (Wulfen) Fr.				
<i>Hygrophorus eburneus</i> (Bull.) Fr.	Agaricales, Hygrophoraceae	Gilan	Saber 1995f	
<i>!Hygrophorus mesotephrus</i> Berk. & Broome	Agaricales, Hygrophoraceae	East Azerbaijan	Asef 2007b	
<i>!Hygrophorus persoonii</i> Arnolds <i>Hygrophorus dichrous</i> Kühner & Romagnesi (invalid name)	Agaricales, Hygrophoraceae	Gilan, Mazandaran	Saber 2000c	
<i>●Hymenopellis radicata</i> (Relhan) R.H. Petersen	Agaricales, Physalacriaceae	East Azerbaijan, Gilan, Golestan, Mazandaran	Saber 1998, Asef & Etemad 2016, this study	MT535683
<i>Oudemansiella radicata</i> (Relhan) Singer, <i>Xerula radicata</i> (Relhan) Dörfelt				
<i>!Hypholoma capnoides</i> (Fr.) P. Kumm.	Agaricales, Strophariaceae	Mazandaran	Saber & Zangeneh 2004	
<i>●Hypholoma fasciculare</i> (Huds.) P. Kumm.	Agaricales, Strophariaceae	East Azerbaijan, Gilan, Golestan, Mazandaran, Razavi Khorasan	Buhse 1860, Watling & Gregory 1977, Zokaei 2001, Saber & Zangeneh 2002, Asef & Tavanaei 2004, Asef 2007b, Asef & Etemad 2016, Bari et al. 2019, Ziaie Juybari et al. 2019, this study Asef & Etemad 2016	MT535706, KX169250 (as endophyte)
<i>Hypholoma elaeodes</i> (Fr.) Gillet				
<i>Hypholoma lateritium</i> (Schaeff.) P. Kumm.	Agaricales, Strophariaceae	Mazandaran		
<i>Hypholoma sublateritium</i> (Fr.) Quél.				
<i>!Hypholoma radicosum</i> J.E. Lange	Agaricales, Strophariaceae	East Azerbaijan, Gilan	Saber 1993a, Asef 2007b	
<i>Hypholoma epixanthum</i> (Fr.) Quél.				
<i>!Hypholoma subericaceum</i> (Fr.) Kühner	Agaricales, Strophariaceae	Gilan	Saber 1993a	
<i>Hypsizygus ulmarius</i> (Bull.) Redhead	Agaricales, Lyophyllaceae	Golestan	Saber 1995e, Saber 1997a	
<i>●Imleria badia</i> (Fr.) Vizzini	Boletales, Boletaceae	‘Hyrcan’	Bahram et al. 2012	FR852283 (env., SH2143392.08FU)
<i>Boletus badius</i> (Fr.) Fr.				
<i>Infundibulicybe geotropa</i> (Bull. ex DC.) Harmaja	Agaricales, incertae sedis	East Azerbaijan	Asef & Tavanaei 2004, Asef 2007b and 2009b	
<i>Clitocybe geotropa</i> (Bull. ex DC.) Quél.				
<i>Infundibulicybe gibba</i> (Pers.) Harmaja	Agaricales, incertae sedis	Mazandaran	Asef & Etemad 2016	
<i>Infundibulicybe trulliformis</i> (Fr.) Gminder	Agaricales, incertae sedis	East Azerbaijan	Asef 2009b	
<i>Clitocybe trulliformis</i> (Fr.) P. Karst.				
<i>●Inocybe amethystina</i> Kuyper	Agaricales, Inocybaceae	Mazandaran?	Bahram et al. 2013	HE687066 (env., SH1975517.08FU)
<i>●Inocybe asterospora</i> Quél.	Agaricales, Inocybaceae	Gilan, ‘Hyrcan’, Mazandaran	Saber 1994c and 1999, Bahram et al. 2012	FR852223 (env., SH2563972.08FU)

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
● <i>Inocybe castaneicolor</i> A. La Rosa, Bizio, Saitta & Tedersoo	Agaricales, Inocybaceae	‘Hyrcan’, Mazandaran?	Bahram et al. 2012, 2013	FR852226 (env., SH2183488.08FU), HE687070 (env., SH2183488.08FU)
● <i>Inocybe cincinnata</i> (Fr.) Quél.	Agaricales, Inocybaceae	‘Hyrcan’	Bahram et al. 2012	FR852255 (env., SH2338401.08FU)
! <i>Inocybe corydalina</i> Quél.	Agaricales, Inocybaceae	Isfahan	Saber & Esmaeili Taheri 2002	
● <i>Inocybe decemgibbosa</i> (Kühner) Vauras	Agaricales, Inocybaceae	Mazandaran?	Bahram et al. 2013	HE687073 (env., SH2187666.08FU)
<i>Inocybe dulcamara</i> (Pers.) P. Kumm.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inocybe erubescens</i> A. Blytt	Agaricales, Inocybaceae	Golestan	Saber 1999	
<i>Inocybe patouillardii</i> Bres.	Agaricales, Inocybaceae	Mazandaran?	Bahram et al. 2013	HE687062 (env., SH1952027.08FU)
● <i>Inocybe flocculosa</i> Sacc.	Agaricales, Inocybaceae	Mazandaran	Saber 1994c and 1999, Bahram et al. 2013	HE687075 (env., SH2187809.08FU)
● <i>Inocybe geophylla</i> (Sowerby) P. Kumm.	Agaricales, Inocybaceae	Mazandaran?	Bahram et al. 2013	HE687071 (env., SH2183506.08FU)
● <i>Inocybe godeyi</i> Gillet	Agaricales, Inocybaceae	‘Hyrcan’, Isfahan	Saber & Esmaeili Taheri 2002, Bahram et al. 2012	FR852249 (env., SH2081453.08FU)
● <i>Inocybe hirtella</i> Bres.	Agaricales, Inocybaceae	‘Hyrcan’	Bahram et al. 2012	FR852248 (env., SH1928024.08FU)
● <i>Inocybe huijsmanii</i> Kuyper	Agaricales, Inocybaceae	Mazandaran?	Bahram et al. 2013	HE687072 (env., SH1932718.08FU)
● <i>Inocybe langei</i> R. Heim	Agaricales, Inocybaceae	East Azerbaijan	Asef 2007b	
! <i>Inocybe leptocystis</i> G.F. Atk.	Agaricales, Inocybaceae	Gilan, Golestan, Mazandaran	Saber 1994c and 1999	
<i>Inocybe lilacina</i> (Peck) Kauffman	Agaricales, Inocybaceae	Mazandaran?	Bahram et al. 2013	HE687061 (env., SH2125306.08FU)
<i>Inocybe geophylla</i> var. <i>lilacina</i> (Peck) Gillet	Agaricales, Inocybaceae	‘Hyrcan’	Bahram et al. 2012	FR852253 (env., SH2258584.08FU)
● <i>Inocybe mixtilis</i> (Britzelm.) Sacc.	Agaricales, Inocybaceae	Mazandaran	Saber 1999	
● <i>Inocybe mystica</i> Stangl & Glowinski	Agaricales, Inocybaceae	Mazandaran	Saber 1999	
<i>Inocybe napipes</i> J.E. Lange	Agaricales, Inocybaceae	Gilan	Saber 1999	
<i>Inocybe paludinella</i> (Peck) Sacc.	Agaricales, Inocybaceae	Golestan	Saber 1994c and 1999	
<i>Inocybe praetervisa</i> Quél.	Agaricales, Inocybaceae	‘Hyrcan’	Bahram et al. 2012	FR852266 (env., SH1891582.08FU)
● <i>Inocybe pusio</i> P. Karst.	Agaricales, Inocybaceae	Kermanshah	Fadavi et al. 2015	
<i>Inocybe subnudipes</i> Kühner	Agaricales, Inocybaceae	Mazandaran	Saber 1994c and 1999	
<i>Inocybe tabacina</i> Furrer-Ziogas	Agaricales, Inocybaceae	Kermanshah	Fadavi et al. 2015	
<i>Inocybe terrifera</i> Kühner	Agaricales, Inocybaceae	Mazandaran	Saber 1994c and 1999	
<i>Inosperma adaequatum</i> (Britzelm.) Matheny & Esteve-Rav.	Agaricales, Inocybaceae	Isfahan, Mazandaran	Saber 1999, Saber & Esmaeili Taheri 2002	
<i>Inocybe adaequata</i> (Britzelm.) Sacc.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inosperma bongardii</i> (Weinm.) Matheny & Esteve-Rav.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inocybe bongardii</i> (Weinm.) Quél.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inosperma cookei</i> (Bres.) Matheny & Esteve-Rav.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inocybe cookei</i> Bres.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inosperma maculatum</i> (Boud.) Matheny & Esteve-Rav.	Agaricales, Inocybaceae	Gilan, Mazandaran	Saber 1994c and 1999	
<i>Inocybe maculata</i> Boud.	Agaricales, Inocybaceae	Gilan, ‘Hyrcan’	Saber 1998, Bahram et al. 2012	FR852306 (env., SH2252734.08FU)
● <i>Laccaria amethystina</i> Cooke	Agaricales, Hydangiaceae	Gilan, Golestan, Mazandaran	Saber 1998	
! <i>Laccaria bicolor</i> (Maire) P.D. Orton	Agaricales, Hydangiaceae			

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Laccaria laccata</i> (Scop.) Cooke	Agaricales, Hydnangiaceae	East Azerbaijan, Mazandaran	Asef 2007b, Asef & Etemad 2016	
! <i>Laccaria tortilis</i> (Bolton) Cooke	Agaricales, Hydnangiaceae	Mazandaran	Saber 1998	
<i>Lacrymaria lacrymabunda</i> (Bull.) Pat.	Agaricales, Psathyrellaceae	Mazandaran	Soleimani 1974, Saber 1994b	
<i>Drosophila velutina</i> (Pers.) Kühner & Romagn., <i>Psathyrella velutina</i> (Pers.) Singer				
● <i>Lactarius acris</i> (Bolton) Gray	Russulales, Russulaceae	‘Hyrcaan’	Bahram et al. 2012	FR852031 (env. SH2040289.08FU)
● <i>Lactarius circellatus</i> Fr.	Russulales, Russulaceae	‘Hyrcaan’	Bahram et al. 2012	FR852038 (env., SH2160217.08FU)
<i>Lactarius deliciosus</i> (L.) Gray	Russulales, Russulaceae	Gilan	Saber 1989a	
● <i>Lactarius fulvissimus</i> Romagn.	Russulales, Russulaceae	‘Hyrcaan’	Bahram et al. 2012	FR852027 (env., SH2160802.08FU)
● <i>Lactarius rubrocinctus</i> Fr.	Russulales, Russulaceae	Mazandaran	Bahram et al. 2012, 2013	UDB005361 (env., SH2160166.08FU)
<i>Lactarius scrobiculatus</i> (Scop.) Fr.	Russulales, Russulaceae	Gilan, Golestan	Saber 1989a	
<i>Lactarius serifluus</i> (DC.) Fr.	Russulales, Russulaceae	East Azerbaijan	Asef 2007b and 2011a	
● <i>Lactarius subdulcis</i> (Pers.) Gray	Russulales, Russulaceae	Gilan, Mazandaran	Saber 1989a, Bahram et al. 2012, 2013	KX395722, UDB005356
● <i>Lactarius tabidus</i> Fr.	Russulales, Russulaceae	Golestan, Mazandaran	Saber 1989a, Bahram et al. 2012, 2013	UDB005472
<i>Lactarius theiogalus</i> (Bull.) Gray				
● <i>Lactarius zonarius</i> (Bull.) Fr.	Russulales, Russulaceae	‘Hyrcaan’	Bahram et al. 2012	FR852035 (env., SH1878819.08FU)
● <i>Lactifluus glaucescens</i> (Crossl.) Verbeke	Russulales, Russulaceae	‘Hyrcaan’, Mazandaran	Saber 1997c, Bahram et al. 2012, this study	MT535681 , FR852034 (env., SH1939607.08FU)
<i>Lactarius glaucescens</i> Crossl.				
<i>Lactifluus piperatus</i> (L.) Roussel	Russulales, Russulaceae	Gilan, Golestan, Isfahan?	Khabiri 1968, Saber 1989a	
<i>Lactarius piperatus</i> (L.) Pers.				
● <i>Lactifluus vellereus</i> (Fr.) Kuntze	Russulales, Russulaceae	Gilan, ‘Hyrcaan’, Mazandaran	Saber 1989a, Bahram et al. 2012	FR852039 (env., SH1873315.08FU)
<i>Lactarius vellereus</i> (Fr.) Fr.				
<i>Lactifluus volemus</i> (Fr.) Kuntze	Russulales, Russulaceae	East Azerbaijan, Golestan	Saber 1989a, Asef 2007b and 2011a	
<i>Lactarius volemus</i> (Fr.) Fr.				
● <i>Leccinellum pseudoscabrum</i> (Kallenb.) Mikšik	Boletales, Boletaceae	East Azerbaijan, Mazandaran	Saber 1995d, Asef 2008, Bahram et al. 2013	HE687078 (env., SH1726911.08FU)
<i>Leccinum griseum</i> (Quél.) Singer,				
<i>Leccinum pseudoscabrum</i> (Kallenb.) Šutara				
! <i>Leccinum scabrum</i> (Bull.) Gray	Boletales, Boletaceae	Golestan	Saber 1995d	
! <i>Leccinum versipelle</i> (Fr. & Hök) Snell	Boletales, Boletaceae	Gilan	Saber 1995d	
<i>Leccinum testaceoscabrum</i> Secr. ex Singer				
<i>Lentinellus cochleatus</i> (Pers.) P. Karst.	Russulales, Auriscalpiaceae	Gilan	Saber 1990	
<i>Lentinellus ursinus</i> (Fr.) Kühner	Russulales, Auriscalpiaceae	Golestan	Saber 1997a	
<i>Lentinellus vulpinus</i> (Sowerby) Kühner & Maire	Russulales, Auriscalpiaceae	Golestan	Saber 1990	
<i>Lentinus cyathiformis</i> (Schaeff.) Bres.	Polyporales, Polyporaceae	Gilan	Saber 1990	
<i>Neolentinus schaefferi</i> (Weinm.) Redhead & Ginns				
<i>Lentinus lepideus</i> (Fr.) Fr.	Polyporales, Polyporaceae	Alborz, Mazandaran	Soleimani 1974 and 1976	
<i>Neolentinus suffrutescens</i> (Brot.) T.W. May & A.E. Wood				
<i>Lentinus sajor-caju</i> (Fr.) Fr.	Polyporales, Polyporaceae	Golestan	Bari et al. 2019	
<i>Pleurotus sajor-caju</i> (Fr.) Singer				
<i>Lentinus strigosus</i> Fr.	Polyporales, Polyporaceae	Gilan, Golestan, Mazandaran	Soleimani 1974 and 1976; Saber 1990 and 1997a	
<i>Panus rudis</i> Fr.	Polyporales, Polyporaceae			
<i>Lepiota anthomyces</i> (Berk. & Broome) Sacc.	Agaricales, Agaricaceae	Khuzestan	Mohammadi Goltapeh 2002	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
• <i>Lentinus tigrinus</i> (Bull.) Fr. <i>Panus tigrinus</i> (Bull.) Singer	Polyporales, Polyporaceae	Alborz, East Azerbaijan, Gilan, Kermanshah, Kohgiluyeh and Boyer-Ahmad, Lorestan, Mazandaran, Tehran Gilan	Petrak 1940, Watling & Sweeney 1974, Soleimani 1974 and 1976, Saber 1990, Saber & Esmaili Taheri 2004, Grand et al. 2011, Fadavi et al. 2015, Ghobad- Nejhad et al. 2017 (as endophyte), this study	MT535686, MG208016 (as endophyte)
<i>Lepiota brunneoincarnata</i> Chodat & C. Martin	Agaricales, Agaricaceae		Asef 2015	
<i>Lepiota castanea</i> Quél.	Agaricales, Agaricaceae	East Azerbaijan, Mazandaran	Saber 1994a, Asef & Tavanaei 2004, Asef 2007b, Asef & Etemad 2016	
<i>Lepiota cristata</i> (Bolton) P. Kumm.	Agaricales, Agaricaceae	Alborz, East Azerbaijan, Gilan, Isfahan, Razavi Khorasan Golestan	Saber 1995f, Zokaei 2001, Mohammadi Goltapeh 2002, Saber & Esmaili Taheri 2002, Asef 2007b Asef 2015	
<i>Lepiota echinella</i> Quél. & G.E. Bernard	Agaricales, Agaricaceae			
! <i>Lepiota felina</i> (Pers.) P. Karst.	Agaricales, Agaricaceae	?	Saber 1994a	
<i>Lepiota helveola</i> Bres.	Agaricales, Agaricaceae	West Azerbaijan	Fallahyan 1973	
<i>Lepiota leprica</i> (Berk. & Broome) Sacc.	Agaricales, Agaricaceae	Mazandaran	Mohammadi Goltapeh 2001	
! <i>Lepiota lilacea</i> Bres.	Agaricales, Agaricaceae	Isfahan	Saber 1994a, Saber & Esmaili Taheri 2002	
<i>Lepiota metulispora</i> (Berk. & Broome) Sacc.	Agaricales, Agaricaceae	Khuzestan	Mohammadi Goltapeh 2002	
! <i>Lepiota micropholis</i> (Berk. & Broome) Sacc.	Agaricales, Agaricaceae	?	Saber 1994a	
! <i>Lepiota subalba</i> Kühner ex P.D. Orton	Agaricales, Agaricaceae	?	Saber 1994a	
<i>Lepiota subincarnata</i> J.E. Lange	Agaricales, Agaricaceae	Mazandaran	Asef 2015	
! <i>Lepista irina</i> (Fr.) H.E. Bigelow	Agaricales, incertae sedis	Golestan	Saber 2002a	
! <i>Lepista nuda</i> (Bull.) Cooke	Agaricales, incertae sedis	East Azerbaijan, Gilan	Saber 2002a	
• <i>Lepista saeva</i> (Fr.) P.D. Orton	Agaricales, incertae sedis	Mazandaran, Razavi Khorasan, Zanjan Lorestan	Zokaei 2001, Saber 2002a, Saber & Zangeneh 2004	MK785234
<i>Lepista personata</i> (Fr.) Cooke				
! <i>Leratiomyces squamosus</i> (Pers.) Bridge & Spooner	Agaricales, Strophariaceae			
<i>Stropharia squamosa</i> (Pers.) Quél.				
• <i>Leucoagaricus americanus</i> (Peck) Vellinga	Agaricales, Agaricaceae	Mazandaran, West Azerbaijan	Saber 1994a, Saber & Mehravaran 2004, GenBank	MT573394
<i>Lepiota americana</i> (Peck) Sacc, <i>Leucoagaricus bresadolae</i> (Schulzer) Bon & Boiffard				
! <i>Leucoagaricus badhamii</i> (Berk. & Broome) Singer	Agaricales, Agaricaceae	Mazandaran	Saber 2000c	
<i>Leucocoprinus badhamii</i> (Berk. & Broome) Locq.				
<i>Leucoagaricus carneifolius</i> (Gillet) Wasser	Agaricales, Agaricaceae	Kermanshah	Fadavi et al. 2015	
<i>Leucoagaricus holospilotus</i> (Berk. & Broome) Bon	Agaricales, Agaricaceae	Mazandaran	Mohammadi Goltapeh 2001	
<i>Leucocoprinus holospilotus</i> (Berk. & Broome) D.A. Reid, <i>Lepiota</i> <i>holospilota</i> (Berk. & Broome) Sacc.				
• <i>Leucoagaricus leucothites</i> (Vittad.) Wasser	Agaricales, Agaricaceae	Isfahan, Mazandaran, Tehran	Saber 1994a, Saber & Esmaili Taheri 2002, Asef & Etemad 2016, this study	MT535696
<i>Lepiota naucina</i> (Fr.) P. Kumm., <i>Leucoagaricus naucinus</i> (Fr.) Singer				
! <i>Leucoagaricus nymphaeum</i> (Kalchbr.) Bon	Agaricales, Agaricaceae	Gilan	Saber 1995f	
<i>Macrolepiota puellaris</i> (Fr.) M.M. Moser				

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Leucoagaricus roseoalbus</i> (Henn.) Heinem. <i>Lepiota roseoalba</i> Henn.	Agaricales, Agaricaceae	Tehran	Mohammadi Goltapeh 2002	
<i>Leucoagaricus serenus</i> (Fr.) Bon & Boiffard	Agaricales, Agaricaceae	Khuzestan	Mohammadi Goltapeh 2002	
<i>Lepiota serena</i> (Fr.) Quél.				
<i>!Leucocoprinus birnbaumii</i> (Corda) Singer	Agaricales, Agaricaceae	?	Saber 1994a	
<i>!Leucocoprinus brebissonii</i> (Godey) Locq.	Agaricales, Agaricaceae	?	Saber 1994a	
<i>!Leucocoprinus cepistipes</i> (Sowerby) Pat.	Agaricales, Agaricaceae	?	Saber 1994a	
<i>Lepiota cepistipes</i> (Sowerby) P. Kumm.				
<i>!Leucocoprinus magnusianus</i> (Henn.) Singer	Agaricales, Agaricaceae	Mazandaran	Saber 2000c	
<i>!Leucocybe candicans</i> (Pers.) Vizzini, P. Alvarado, G. Moreno & Consiglio	Agaricales, incertae sedis	Mazandaran	Saber 2002a	
<i>Clitocybe candicans</i> (Pers.) P. Kumm.				
<i>Leucocybe houghtonii</i> (W. Phillips) Halama & Pencakowski	Agaricales, incertae sedis	East Azerbaijan	Asef 2009b	
<i>Clitocybe houghtonii</i> (W. Phillips) Dennis				
<i>!Leucopaxillus compactus</i> (P. Karst.) Neuhoﬀ	Agaricales, Tricholomataceae	Mazandaran	Saber 2002a	
<i>!Leucopaxillus giganteus</i> (Sowerby) Singer	Agaricales, Tricholomataceae	East Azerbaijan	Saber 2002a	
<i>!Leucopaxillus pinicola</i> J. Favre	Agaricales, Tricholomataceae	Mazandaran	Saber 2002a	
<i>!Lyophyllum atratum</i> (Fr.) Singer	Agaricales, Lyophyllaceae	Mazandaran	Saber 2002a	
<i>Tephrocybe atrata</i> (Fr.) Donk				
<i>!Lyophyllum baeospermum</i> Romagn.	Agaricales, Lyophyllaceae	Mazandaran	Saber 2002b	
<i>Tephrocybe baeosperma</i> (Romagn.) M.M. Moser				
<i>•Macrocybe gigantea</i> (Massee) Pegler & Lodge	Agaricales, Biannulariaceae	Ilam	Yousefshahi et al. 2020	MG867660
<i>Tricholoma giganteum</i> Massee				
<i>!Macrolepiota excoriata</i> (Schaeff.) Wasser	Agaricales, Agaricaceae	?	Saber 1994a	
<i>!Macrolepiota mastoidea</i> (Fr.) Singer	Agaricales, Agaricaceae	East Azerbaijan	Saber 1994a, Saber & Zangeneh 2002, Asef 2007b	
<i>Macrolepiota konradii</i> (Huijsman ex P.D. Orton) M.M. Moser,				
<i>Macrolepiota prominens</i> (Sacc.) M.M. Moser				
<i>!Macrolepiota permixta</i> (Barla) Pacioni	Agaricales, Agaricaceae	Mazandaran	Saber & Zangeneh 2002	
<i>Macrolepiota procera</i> (Scop.) Singer	Agaricales, Agaricaceae	East Azerbaijan, Mazandaran, Razavi Khorasan	Saber 1994a, Mohammadi Goltapeh 2001, Asef & Etemad 2016	
<i>Mallocybe terrigena</i> (Fr.) Matheny, Vizzini & Esteve-Rav.	Agaricales, Inocybaceae	Hamadan	Jadidian et al. 2015	
<i>Inocybe terrigena</i> (Fr.) Kuyper				
<i>•Marasmiellus candidus</i> (Fr.) Singer	Agaricales, Omphalotaceae	Gilan, Golestan, Mazandaran	Saber 1995g, Asef & Etemad 2016	MT573397
<i>!Marasmiellus confluens</i> (Pers.) J.S. Oliveira	Agaricales, Omphalotaceae	Gilan	Saber 1998	
<i>Collybia confluens</i> (Pers.) P. Kumm., <i>Gymnopus confluens</i> (Pers.) Antonín, Halling & Noordel.				
<i>!Marasmiellus peronatus</i> (Bolton) J.S. Oliveira	Agaricales, Omphalotaceae	Gilan, Mazandaran	Saber 1998	
<i>Collybia peronata</i> (Bolton) P. Kumm., <i>Gymnopus peronatus</i> (Bolton) Gray				
<i>!Marasmiellus ramealis</i> (Bull.) Singer	Agaricales, Omphalotaceae	Gilan, Golestan, Mazandaran	Saber 1995g	
<i>Marasmius ramealis</i> (Bull.) Fr.				

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
! <i>Marasmius atrorubens</i> (Berk.) Mont.	Agaricales, Marasmiaceae	Gilan, Mazandaran, Tehran	Mohammadi Goltapeh 2004	
! <i>Marasmius corrugatifomis</i> Singer	Agaricales, Marasmiaceae	Gilan, Mazandaran, Tehran	Mohammadi Goltapeh 2004	
! <i>Marasmius epiphyllus</i> (Pers.) Fr.	Agaricales, Marasmiaceae	Gilan	Saber 1995g	
! <i>Marasmius favoloides</i> Henn.	Agaricales, Marasmiaceae	Gilan, Mazandaran, Tehran	Mohammadi Goltapeh 2004	
! <i>Marasmius ferrugineus</i> Berk. & M.A. Curtis	Agaricales, Marasmiaceae	Gilan, Mazandaran, Tehran	Mohammadi Goltapeh 2004	
! <i>Marasmius haematocephalus</i> (Mont.) Fr.	Agaricales, Marasmiaceae	Gilan, Mazandaran, Tehran	Mohammadi Goltapeh 2004	
! <i>Marasmius oreades</i> (Bolton) Fr.	Agaricales, Marasmiaceae	Gilan, West Azerbaijan	Saber 1995g, Saber & Mehrvaran 2004	
<i>Marasmius rotula</i> (Scop.) Fr.	Agaricales, Marasmiaceae	Gilan, Golestan, Mazandaran	Watling & Sweeney 1974, Soleimani 1974 and 1976, Saber 1995g	
! <i>Marasmius rubroflavus</i> (Theiss.) Singer	Agaricales, Marasmiaceae	Gilan, Mazandaran, Tehran	Mohammadi Goltapeh 2004	
<i>Marasmius wynneae</i> Berk. & Broome	Agaricales, Marasmiaceae	Mazandaran	Saber 1995g, Ershad 1995	
• <i>Megacollybia platyphylla</i> (Pers.) Kotl. & Pouzar	Agaricales, Marasmiaceae		Saber 2000d, Saber & Zangeneh 2002, Asef & Etemad 2016, this study	MT535698
<i>Oudemansiella platyphylla</i> (Pers.) M.M. Moser		Gilan, Golestan, Mazandaran		
! <i>Melanoleuca cognata</i> (Fr.) Konrad & Maubl.	Agaricales, incertae sedis	Lorestan	Saber 2000d	
*• <i>Melanoleuca excissa</i> (Fr.) Singer	Agaricales, incertae sedis	East Azerbaijan	this study	MT535742
! <i>Melanoleuca graminicola</i> (Velen.) Kühner & Maire	Agaricales, incertae sedis	Tehran	Saber 2000d	
! <i>Melanoleuca grammopodia</i> (Bull.) Fayod	Agaricales, incertae sedis	Tehran	Saber 2000d	
! <i>Melanoleuca strictipes</i> (P. Karst.) Jul. Schäff.	Agaricales, incertae sedis	Tehran	Saber 2000d	
! <i>Melanoleuca subpulverulenta</i> (Pers.) Métrod	Agaricales, incertae sedis	Golestan, Tehran	Saber 2000d	
<i>Montagnea arenaria</i> (DC.) Zeller <i>Montagnea arenaria</i> var. <i>macrospora</i> D.A. Reid & Eicker, <i>Montagnites arenarius</i> (DC.) Morse	Agaricales, Agaricaceae	Fars, Kerman, Qom, Razavi Khorasan, Semnan, Sistan and Baluchestan	Petrak 1940 and 1949, Watling & Gregory 1977, Esfandiari 1951, Saber 1986 and 2000b and 2002b, Saber & Esmaeili Taheri 2004, this study	
<i>Montagnea haussknechtii</i> Rabenh.	Agaricales, Agaricaceae	Gilan	Rabenhorst 1871	
<i>Mycena acicula</i> (Schaeff.) P. Kumm.	Agaricales, Mycenaceae	East Azerbaijan	Asef & Muradov 2014	
<i>Mycena clavicularis</i> (Fr.) Gillet	Agaricales, Mycenaceae	East Azerbaijan	Asef & Muradov 2014	
<i>Mycena crocata</i> (Schr.) P. Kumm.	Agaricales, Mycenaceae	Gilan, Golestan, Mazandaran	Saber 1995h, Asef & Etemad 2016, this study	
! <i>Mycena filopes</i> (Bull.) P. Kumm. <i>Mycena amygdalina</i> (Pers.) Singer (s. Singer)	Agaricales, Mycenaceae	Gilan, Golestan	Saber 1995h	
! <i>Mycena galericulata</i> (Scop.) Gray	Agaricales, Mycenaceae	Gilan, Golestan, Mazandaran	Saber 1995h	
<i>Mycena galopus</i> (Pers.) P. Kumm.	Agaricales, Mycenaceae	Razavi Khorasan	Zokaei 2001	
<i>Mycena haematopus</i> (Pers.) P. Kumm.	Agaricales, Mycenaceae	Gilan, Golestan, Mazandaran	Saber 1995h, this study	
! <i>Mycena inclinata</i> (Fr.) Quél.	Agaricales, Mycenaceae	Gilan, Golestan, Mazandaran	Saber 1995h	
! <i>Mycena metata</i> (Fr.) P. Kumm.	Agaricales, Mycenaceae	Golestan	Saber 1995h	
! <i>Mycena pearsoniana</i> Dennis ex Singer	Agaricales, Mycenaceae	Gilan	Saber 1995h	
! <i>Mycena pelianthina</i> (Fr.) Quél.	Agaricales, Mycenaceae	Gilan	Saber 1995h	
! <i>Mycena polygramma</i> (Bull.) Gray	Agaricales, Mycenaceae	Gilan	Saber 1995h	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
!Mycena pura (Pers.) P. Kumm.	Agaricales, Mycenaceae	Gilan	Saber 1995h	
!Mycena rapiolens J. Favre	Agaricales, Mycenaceae	Mazandaran	Saber 1995h	
!Mycena sanguinolenta (Alb. & Schwein.) P. Kumm.	Agaricales, Mycenaceae	Mazandaran	Saber 1995h	
*●Mycena xantholeuca Kühner	Agaricales, Mycenaceae	Ilam	this study	MT535719, MT535733
Mycenastrum corium (Guers.) Desv.	Agaricales, Agaricaceae	Mazandaran, Tehran	Saber 1993b and 1995b	
!Mycenella salicina (Velen.) Singer	Agaricales, incertae sedis	Mazandaran	Saber 1995h	
Mycetinis alliaceus (Jacq.) Earle	Agaricales,	Gilan, Golestan,	Watling & Sweeney 1974, Saber	
Marasmius alliaceus (Jacq.) Fr.	Marasmiaceae	Mazandaran	1995g	
!Mycetinis scorodonius (Fr.) A.W. Wilson & Desjardin	Agaricales,	Gilan, Mazandaran	Saber 1995g	
Marasmius scorodonius (Fr.) Fr.	Marasmiaceae			
!Myxomphalia maura (Fr.) Hora	Agaricales, incertae sedis	Tehran	Saber 2002a	
Neoboletus luridiformis (Rostk.) Gelardi	Boletales, Boletaceae	East Azerbaijan	Asef 2007b and 2008	
Boletus erythropus Pers., Neoboletus erythropus (Pers.) C. Hahn				
Neofavolus suavissimus (Fr.) J.S. Seelan, Justo & Hibbett	Polyporales, Polyporaceae	Gilan, Sistan and Baluchestan	Saber 1990	
Lentinus suavissimus Fr.				
Neolentinus adhaerens (Alb. & Schwein.) Redhead & Ginns	Polyporales, Polyporaceae	Gilan, Mazandaran	Watling & Sweeney 1974, Saber 1990	
Lentinus adhaerens (Alb. & Schwein.) Fr., Lentinus pulverulentus (Scop.) Fr.				
!Omphaliaster asterosporus (J.E. Lange) Lamoure	Agaricales, incertae sedis	Golestan	Saber 1993d	
Hygroaster asterosporus (J.E. Lange) Singer				
!Omphalina mutila (Fr.) P.D. Orton	Agaricales, incertae sedis	Razavi Khorasan	Saber & Esmaeli Taheri 2004	
Clitocybe josserandii (Singer) Singer				
!Omphalina pyxidata (Bull.) Quél.	Agaricales, incertae sedis	Gilan	Saber 2002a	
Omphalotus olearius (DC.) Singer	Agaricales, Omphalotaceae	Gilan, Golestan, Mazandaran	Saber 1990, Bari et al. 2019	
Ossicaulis lignatilis (Pers.) Redhead & Ginns	Agaricales, Lyophyllaceae	Mazandaran	Saber 1993c, Saber 1997a	
Clitocybe lignatilis (Pers.) P. Karst. (as 'Clitocybe pignatilis')				
*●Ossicaulis salomii Siquier & Bellanger	Agaricales, Lyophyllaceae	Tehran	this study	MT535738
Panaeolus acuminatus (P. Kumm.) Quél.	Agaricales, incertae sedis	Mazandaran	Asef & Etemad 2016	
Panaeolus campanulatus (L.) Quél.	Agaricales, incertae sedis	Gilan	Buhse 1860, Khabiri 1968	
!Panaeolus fimicola (Fr.) Quél.	Agaricales, incertae sedis	East Azerbaijan	Asef 2007b	
●Panaeolus olivaceus F.H. Møller	Agaricales, incertae sedis	Kermanshah	Seidmohammadi et al. 2019	MH593015
Notes: identity doubtful, with caution.				
Panaeolus papilionaceus (Bull.) Quél.	Agaricales, incertae sedis	East Azerbaijan, Mazandaran	Watling & Sweeney 1974, Saber 1995f	
Panaeolus sphinctrinus (Fr.) Quél.				
!Panaeolus plantaginiformis (Lebedeva) E.F. Malysheva	Agaricales, incertae sedis	Golestan	Saber 1993f	
Galeropsis plantaginiformis (Lebedeva) Singer				
Panaeolus rickenii Hora	Agaricales, incertae sedis	Razavi Khorasan	Zokaei 2001	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Panaeolus semiovatus</i> (Sowerby) S. Lundell & Nannf., <i>Panaeolus phalaenarum</i> (Fr.) Quél.	Agaricales, incertae sedis	Mazandaran	Watling & Sweeney 1974	
! <i>Panaeolus speciosus</i> P.D. Orton <i>Panaeolus subfirmus</i> P. Karst.	Agaricales, incertae sedis	?	Saber 1994b	
<i>Panaeolus teutonicus</i> Bride & Métrod	Agaricales, incertae sedis	Mazandaran	Watling & Gregory 1977	
<i>Panellus stipticus</i> (Bull.) P. Karst. <i>Panus stipticus</i> (Bull.) Fr.	Polyporales, Panaceae	Gilan, Golestan, Mazandaran	Rabenhorst 1871, Soleimani 1974 and 1976, Saber 1990, Saber 1994b, Asef & Etemad 2016	
<i>Panus conchatus</i> (Bull.) Fr.	Polyporales, Panaceae	Gilan, Mazandaran	Soleimani 1974 and 1976	
! <i>Paragymnopus perforans</i> (Hoffm.) J.S. Oliveira <i>Micromphale perforans</i> (Hoffm.) Gray	Agaricales, Marasmiaceae	Gilan, Golestan, Mazandaran	Saber 1995g	
<i>Paralepista flaccida</i> (Sowerby) Vizzini <i>Lepista flaccida</i> (Sowerby) Pat., <i>Clitocybe flaccida</i> (Sowerby) P. Kumm., <i>Clitocybe infundibuliformis</i> Quél.	Agaricales, incertae sedis	East Azerbaijan, Mazandaran	Saber 2002a, Asef & Tavanaei 2004, Asef 2007b and 2009b	
! <i>Parasola auricoma</i> (Pat.) Redhead, Vilgalys & Hopple <i>Coprinus auricomus</i> Pat.	Agaricales, Psathyrellaceae	?	Saber 1994b	
! <i>Parasola hemerobia</i> (Fr.) Redhead, Vilgalys & Hopple <i>Coprinus hemerobius</i> Fr.	Agaricales, Psathyrellaceae	?	Saber 1994b	
! <i>Parasola leioccephala</i> (P.D. Orton) Redhead, Vilgalys & Hopple <i>Coprinus leioccephalus</i> P.D. Orton	Agaricales, Psathyrellaceae	East Azerbaijan	Asef 2007b	
! <i>Parasola miser</i> (P. Karst.) Redhead, Vilgalys & Hopple <i>Coprinus miser</i> P. Karst.	Agaricales, Psathyrellaceae	Isfahan	Saber 1994b, Saber & Esmaeili Taheri 2002	
<i>Parasola plicatilis</i> (Curtis) Redhead, Vilgalys & Hopple <i>Coprinus plicatilis</i> (Curtis) Fr., <i>Coprinus plicatilis</i> var. <i>microsporus</i> Kühner & Joss.	Agaricales, Psathyrellaceae	Mazandaran, Razavi Khorasan, Tehran	Saber 1994b, Mohammadi Goltapeh 2000b, Zokaei 2001	
! <i>Paraxerula causei</i> (Maire) Petersen <i>Oudemansiella renati</i> Cléménçon, <i>Xerula causei</i> Maire	Agaricales, Physalacriaceae	East Azerbaijan	Asef 2007b	
• <i>Paxillus involutus</i> (Batsch) Fr.	Boletales, Paxillaceae	East Azerbaijan, Gilan, Golestan, Mazandaran	Saber 1993d, Asef 2007b, Bahram et al. 2013	HE687082 (env., SH2308624.08FU)
! <i>Phaeomarasmium erinaceus</i> (Fr.) Scherff. ex Romagn.	Agaricales, Inocybaceae	?	Saber 1991b	
! <i>Phaeonematoloma myosotis</i> (Fr.) Bon <i>Pholiota myosotis</i> (Fr.) Singer	Agaricales, Strophariaceae	?	Saber 1991b	
! <i>Phellorinia herculeana</i> (Pers.) Kreisel	Agaricales, Agaricaceae	Golestan	Saber 1993b	
<i>Phloeomana speirea</i> (Fr.) Redhead <i>Mycena speirea</i> (Fr.) Gillet	Agaricales, Mycenaceae	Gilan, Golestan, Mazandaran	Saber 1995h, Asef & Etemad 2016	
• <i>Pholiota adiposa</i> (Batsch) P. Kumm. <i>Pholiota aurivella</i> (Batsch) P. Kumm.	Agaricales, Strophariaceae	Alborz, East Azerbaijan, Golestan, Isfahan, Mazandaran, Razavi Khorasan, Tehran, West Azerbaijan	Soleimani 1974 and 1976, Zokaei 2001, Saber & Esmaeili Taheri 2002, Saber & Mehravaran 2004, Asef & Etemad 2016, this study	MT535689
! <i>Pholiota astragalina</i> (Fr.) Singer	Agaricales, Strophariaceae	?	Saber 1991b	
<i>Pholiota gummosa</i> (Lasch) Singer <i>Pholiota ochrochlora</i> (Fr.) P.D. Orton, <i>Stropharia punctulata</i> Sacc.	Agaricales, Strophariaceae	Alborz, Gilan	Soleimani 1974 and 1976, Saber 1991b, Saber & Zangeneh 2002	
<i>Pholiota highlandensis</i> (Peck) A.H. Sm. & Hesler <i>Pholiota carbonaria</i> (Fr.) Singer	Agaricales, Strophariaceae	Kermanshah	Saber 1991b, Fadavi et al. 2013	
* • <i>Pholiota jahnii</i> Tjall.-Beuk. & Bas	Agaricales, Strophariaceae	East Azerbaijan	this study	MT535737

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Pholiota populnea</i> (Pers.) Kuyper & Tjall.-Beuk.	Agaricales, Strophariaceae	Alborz, Gilan, Tehran	Khabiri 1968, Soleimani 1974 and 1976	
<i>Pholiota destruens</i> (Brond.) Gillet				
<i>!Pholiota scamba</i> (Fr.) M.M. Moser	Agaricales, Strophariaceae	?	Saber 1991b	
<i>!Pholiota spumosa</i> (Fr.) Singer	Agaricales, Strophariaceae	?	Saber 1991b	
<i>Pholiota squarrosa</i> (Oeder) P. Kumm.	Agaricales, Strophariaceae	Golestan, Mazandaran	Saber 1991b, Bari et al. 2019	
<i>Pholiota squarrosoides</i> (Peck) Sacc.	Agaricales, Strophariaceae	Mazandaran	Saber 1991b, this study	
<i>!Pholiotina aporos</i> (Kits van Wav.) Cléménçon	Agaricales, Bolbitiaceae	?	Saber 1993f	
<i>Conocybe aporos</i> Kits van Wav.				
<i>!Pholiotina arrhenii</i> (Fr.) Singer	Agaricales, Bolbitiaceae	Mazandaran	Saber 1993f	
<i>!Pholiotina striipes</i> (Cooke) M.M. Moser	Agaricales, Bolbitiaceae	Gilan	Saber & Zangeneh 2002	
<i>Conocybe striaeipes</i> (Cooke) S. Lundell				
<i>!Pholiotina vexans</i> (P.D. Orton) Bon	Agaricales, Bolbitiaceae	Gilan	Saber 2000c	
<i>Conocybe blattaria</i> (Fr.) Kühner				
<i>!Phyllotopsis nidulans</i> (Pers.) Singer	Agaricales, Phyllotopsidaceae	Mazandaran	Saber 1993c	
<i>Pleurotellus chioneus</i> (Pers.) Kühner	Agaricales, Inocybaceae	Gilan, Golestan	Saber 1990	
<i>Pleurotus calyptratus</i> (Lindblad ex Fr.) Sacc.	Agaricales, Pleurotaceae	Mazandaran	Saber & Abaei 2001	
● <i>Pleurotus cornucopiae</i> (Paulet) Rolland	Agaricales, Pleurotaceae	Golestan, Mazandaran, Tehran, West Azerbaijan Gilan	Soleimani 1976, Saber 1990, Saber & Mehravaran 2004, this study	MT535734
<i>Pleurotus djamor</i> (Rumph. ex Fr.) Boedijn	Agaricales, Pleurotaceae	Gilan	Saber 1990	
<i>Pleurotus placentodes</i> (Berk.) Sacc.				
<i>Pleurotus dryinus</i> (Pers.) P. Kumm.	Agaricales, Pleurotaceae	Mazandaran	Saber 1997a	
<i>Pleurotus elongatipes</i> Peck	Agaricales, Pleurotaceae	Mazandaran	Saber 1997a	
● <i>Pleurotus eryngii</i> (DC.) Quél.	Agaricales, Pleurotaceae	Alborz, Ardabil, Chaharmahal and Bakhtiari, East Azerbaijan, Fars, Isfahan, Kohgiluyeh and Boyer-Ahmad, Kurdistan, Lorestan, South Khorasan, Tehran, West Azerbaijan	Petrak 1940, Esfandiari 1948, Heim 1960, Saber 1990, Saber 1997a, Saber & Esmaeili Taheri 2002 and 2004, Saber & Mehravaran 2004, Ravash et al. 2010, Zervakis et al. 2014, this study	MT535679, HM998837 (numerous sequences in GenBank)
<i>Pleurotus fossulatus</i> (Cooke) Sacc.	Agaricales, Pleurotaceae	Chaharmahal and Bakhtiari, Fars, Kohgiluyeh and Boyer-Ahmad, Kurdistan	Saber 1997a, Ravash et al. 2010	
● <i>Pleurotus nebrodensis</i> (Inzenga) Quél.	Agaricales, Pleurotaceae	Chaharmahal and Bakhtiari, Kohgiluyeh and Boyer-Ahmad, Kurdistan	Saber 1997a, Ravash et al. 2010, Zervakis et al. 2014	HM998835
<i>Pleurotus eryngii</i> var. <i>nebrodensis</i> (Inzenga) Sacc.				
● <i>Pleurotus ostreatus</i> (Jacq.) P. Kumm.	Agaricales, Pleurotaceae	Alborz, East Azerbaijan, Gilan, Golestan, Hamadan, Kermanshah, Mazandaran, North Khorasan, Razavi Khorasan, Tehran, West Azerbaijan	Buhse 1860, Khabiri 1968, Soleimani 1974 and 1976, Saber 1990, Zokaei 2001, Saber & Esmaeili Taheri 2004, Saber & Mehravaran 2004, Asef 2007b, Asef & Etemad 2016, this study	MT535690
<i>Agaricus salignus</i> Pers., <i>Agaricus salignus</i> var. <i>ochraceus</i> Pers.				
<i>Pleurotus pulmonarius</i> (Fr.) Quél.	Agaricales, Pleurotaceae	Gilan, Golestan, Kermanshah, Mazandaran	Saber 1990, Bari et al. 2019	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>!Pluteus aurantiorugosus</i> (Trog) Sacc.	Agaricales, Pluteaceae	Gilan, Mazandaran	Saber 1993e	
• <i>Pluteus cervinus</i> (Schaeff.) P. Kumm.	Agaricales, Pluteaceae	East Azerbaijan, Golestan, Mazandaran	Saber 1991a, Saber & Esmaili Taheri 2004, Asef 2007b, Asef & Etemad 2016, Bari et al. 2019, this study	MT535687
<i>Pluteus atricapillus</i> (Batsch) Fayod			Saber 1991a	
<i>Pluteus chrysophaeus</i> (Schaeff.) Quél.	Agaricales, Pluteaceae	Golestan, Mazandaran		
<i>Pluteus luteovirens</i> Rea				
• <i>Pluteus cinereofuscus</i> J.E. Lange	Agaricales, Pluteaceae	Kermanshah	Seidmohammadi et al. 2018a	MH595963
<i>!Pluteus depauperatus</i> Romagn.	Agaricales, Pluteaceae	Gilan, Golestan, Mazandaran	Saber 1993e	
<i>Pluteus exiguus</i> (Pat.) Sacc.	Agaricales, Pluteaceae	Mazandaran	Watling & Sweeney 1974	
<i>Pluteus leoninus</i> (Schaeff.) P. Kumm.	Agaricales, Pluteaceae	Mazandaran	Saber 1991a, Asef & Etemad 2016	
• <i>Pluteus nanus</i> (Pers.) P. Kumm.	Agaricales, Pluteaceae	Kermanshah, Mazandaran, West Azerbaijan	Saber 1991a, Saber & Mehravaran 2004, Seidmohammadi et al. 2018a	MH595974
<i>!Pluteus pellitus</i> (Pers.) P. Kumm.	Agaricales, Pluteaceae	?	Saber 1991a	
<i>!Pluteus petasatus</i> (Fr.) Gillet	Agaricales, Pluteaceae	?	Saber 1991a	
<i>Pluteus patricius</i> (Schulzer) Boud.				
<i>!Pluteus punctipes</i> P.D. Orton	Agaricales, Pluteaceae	Golestan	Saber 1993e	
<i>Pluteus romellii</i> (Britzelm.) Sacc.	Agaricales, Pluteaceae	Golestan, Isfahan	Saber 1991a, Saber & Esmaili Taheri 2002	
<i>Pluteus salicinus</i> (Pers.) P. Kumm.	Agaricales, Pluteaceae	Golestan, Mazandaran	Saber 1995f	
<i>Pluteus semibulbosus</i> (Lasch) Gillet	Agaricales, Pluteaceae	Mazandaran	Saber 1991a, this study	
<i>Pluteus thomsonii</i> (Berk. & Broome) Dennis	Agaricales, Pluteaceae	Golestan, Mazandaran	Saber 2000c	
<i>!Pluteus umbrosus</i> (Pers.) P. Kumm.	Agaricales, Pluteaceae	?	Saber 1991a	
• <i>Pogonoloma macrocephalum</i> (Schulz.) Sánchez-García	Agaricales, incertae sedis	Golestan, Kermanshah	Watling & Gregory 1977, GenBank	MH595847
<i>Tricholoma macrocephalum</i> Schulz.				
*• <i>Psathyrella bivelata</i> Contu	Agaricales, Psathyrellaceae	Tehran	this study	MT535693
• <i>Psathyrella candolleana</i> (Fr.) Maire	Agaricales, Psathyrellaceae	Fars, Mazandaran, Razavi Khorasan, Sistan and Baluchestan, Tehran, West Azerbaijan Hamadan	Saber 1994b, Saber & Esmaili Taheri 2004, Saber & Mehravaran 2004, Asef & Etemad 2016, Teimoori- Boghsani et al. 2020 (as endophyte), this study	MT535718, MK367774 (as endophyte)
<i>Psathyrella clivensis</i> (Berk. & Broome) P.D. Orton	Agaricales, Psathyrellaceae		Jadidian et al. 2015	
*• <i>Psathyrella fatua</i> (Fr.) Konrad & Maubl.	Agaricales, Psathyrellaceae	Kohgiluyeh and Boyer-Ahmad	this study	MT535695
*• <i>Psathyrella hellebosensis</i> D. Deschuyteneer & A. Melzer	Agaricales, Psathyrellaceae	Semnan	this study	MT535716
<i>!Psathyrella laevisissima</i> (Romagn.) Singer	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>!Psathyrella microrhiza</i> (Lasch) Konrad & Maubl.	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>Psathyrella multipedata</i> (Peck) A.H. Sm.	Agaricales, Psathyrellaceae	Mazandaran	Saber 1994b, Asef & Etemad 2016	
<i>!Psathyrella obtusata</i> (Fr.) A.H. Sm.	Agaricales, Psathyrellaceae	Golestan, Mazandaran, Razavi Khorasan, South Khorasan	Saber 1994b, Saber & Emaeili Taheri 2004	
<i>!Psathyrella pennata</i> (Fr.) A. Pearson & Dennis	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>!Psathyrella piluliformis</i> (Bull.) P.D. Orton	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>Psathyrella hydrophila</i> (Bull.) Maire				

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>!Psathyrella prona</i> (Fr.) Gillet	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>!Psathyrella pseudogracilis</i> (Romagn.) M.M. Moser	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>!Psathyrella spadiceogrisea</i> (Schaeff.) Maire <i>Psathyrella</i> <i>groegeri</i> G. Hirsch, <i>Psathyrella</i> <i>vernalis</i> (J.E. Lange) M.M. Moser	Agaricales, Psathyrellaceae	Mazandaran, West Azerbaijan	Saber 1994b, Saber 1995f, Saber & Mehravaran 2004	
<i>!Psathyrella squamosa</i> (P. Karst.) A.H. Sm.	Agaricales, Psathyrellaceae	?	Saber 1994b	
<i>Psathyrella tephrophylla</i> (Romagn.) M.M. Moser	Agaricales, Psathyrellaceae	Hamadan	Jadidian et al. 2015	
● <i>Pseudoclitocybe cyathiformis</i> (Bull.) Singer	Agaricales, incertae sedis	Gilan, Golestan, Ilam, Mazandaran	Buhse 1860, Saber 2002a, this study	MT535721
<i>Clitocybe cyathiformis</i> (Bull.) P. Kumm.				
<i>Pseudosperma perlatum</i> (Cooke) Matheny & Esteve-Rav.	Agaricales, Inocybaceae	East Azerbaijan, Golestan	Saber 1994c, Saber 1999, Asef 2007b	
<i>Inocybe perlata</i> (Cooke) Sacc.				
● <i>Pseudosperma rimosum</i> (Bull.) Matheny & Esteve-Rav.	Agaricales, Inocybaceae	East Azerbaijan, 'Hyrcan', Ilam, Mazandaran	Saber 1994c, Asef 2007b, Saber 1999, Asef & Tavaneai 2004, Bahram et al. 2012, Yousefshahi et al. 2020	MF278770, FR852236 (env., SH1951094.08FU)
<i>Inocybe fastigiata</i> (Schaeff.) Quél., <i>Inocybe rimosa</i> (Bull.) P. Kumm.			Fadavi et al. 2013	
<i>Psilocybe atrobrunnea</i> (Lasch) Gillet	Agaricales, Hymenogastraceae	Kermanshah		
<i>!Psilocybe coprophila</i> (Bull.) P. Kumm.	Agaricales, Hymenogastraceae	?	Saber 1991b	
<i>!Psilocybe cyanescens</i> Wakef.	Agaricales, Hymenogastraceae	Tehran	Saber 1995f	
<i>!Psilocybe serbica</i> M.M. Moser & E. Horak	Agaricales, Hymenogastraceae	Tehran	Saber 1995f	
<i>Resupinatus applicatus</i> (Batsch) Gray	Agaricales, Pleurotaceae	Mazandaran	Saber 1990	
<i>Rhodocollybia maculata</i> (Alb. & Schwein.) Singer	Agaricales, Omphalotaceae	Gilan	Khabiri 1968	
<i>Collybia maculata</i> (Alb. & Schwein.) P. Kumm.				
<i>!Rhodocollybia prolixa</i> (Fr.) Antonin & Noordel.	Agaricales, Omphalotaceae	Mazandaran	Saber 1998	
<i>Collybia distorta</i> (Fr.) Quél., <i>Rhodocollybia prolixa</i> var. <i>distorta</i> (Fr.) Antonin, Halling & Noordel.				
<i>Rhodotus palmatus</i> (Bull.) Maire	Agaricales, Physalacriaceae	Golestan	Saber 1990	
<i>!Rubroboletus satanas</i> (Lenz) Kuan Zhao & Zhu L. Yang	Boletales, Boletaceae	Golestan, Mazandaran	Saber 1995d	
<i>Boletus satanas</i> Lenz				
<i>!Russula acetolens</i> Rauschert	Russulales, Russulaceae	Mazandaran	Saber 2000a	
<i>Russula lutea</i> (Huds.) Gray	Russulales, Russulaceae	Golestan	Saber & Ershad 2004	
<i>!Russula alutacea</i> (Pers.) Fr.	Russulales, Russulaceae	Mazandaran	Bahram & Asef 2008b	
<i>!Russula anthracina</i> Romagn.	Russulales, Russulaceae	Gilan, 'Hyrcan', Mazandaran	Saber & Ershad 2004, Bahram et al. 2012	FR852111 (env., SH1667944.08FU)
● <i>Russula atropurpurea</i> Peck	Russulales, Russulaceae	Gilan	Saber & Ershad 2004	
<i>!Russula atrorubens</i> Quél.	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
<i>!Russula brunneoviolacea</i> Crawshay	Russulales, Russulaceae	Golestan	Saber & Ershad 2004	
<i>!Russula carminipes</i> J. Blum	Russulales, Russulaceae	Gilan	Saber & Ershad 2004	
<i>!Russula claroflava</i> Grove	Russulales, Russulaceae	East Azerbaijan, Golestan	Saber & Ershad 2004, Asef 2007b and Asef 2011a	
<i>!Russula cyanoxantha</i> (Schaeff.) Fr.	Russulales, Russulaceae			
<i>Russula cyanoxantha</i> f. <i>peltareaui</i> Singer				
● <i>Russula delica</i> Fr.	Russulales, Russulaceae	East Azerbaijan, 'Hyrcan'	Asef 2007b, Asef 2011a, Bahram et al. 2012	FR852108 (env., SH1865348.08FU)

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Russula emetica</i> (Schaeff.) Pers.	Russulales, Russulaceae	East Azerbaijan, Golestan, Mazandaran	Saber & Ershad 2004, Asef 2007b and 2011a	MT535680, MT535682
*● <i>Russula emeticolor</i> J. Schaeffer	Russulales, Russulaceae	Golestan, Mazandaran	this study	
! <i>Russula farinipes</i> Romell	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
● <i>Russula foetens</i> Pers.	Russulales, Russulaceae	Mazandaran	Saber 2000a, Bahram et al. 2013	HE687097 (env., SH1569737.08FU)
! <i>Russula graveolens</i> Romell	Russulales, Russulaceae	Golestan	Saber & Ershad 2004	
! <i>Russula grisea</i> Fr.	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
● <i>Russula heterophylla</i> (Fr.) Fr.	Russulales, Russulaceae	Golestan, 'Hyrcan'	Saber & Ershad 2004, Bahram et al. 2012	FR852114 (env., SH1956732.08FU)
<i>Russula integra</i> (L.) Fr.	Russulales, Russulaceae	Golestan, Mazandaran	Watling & Sweeney 1974, Saber & Ershad 2004	
<i>Russula polychroma</i> Singer ex Hora				
! <i>Russula ionochlora</i> Romagn.	Russulales, Russulaceae	Gilan	Saber & Ershad 2004	
<i>Russula lilacea</i> Quél.	Russulales, Russulaceae	East Azerbaijan	Asef 2007b and 2011a	
● <i>Russula luteotacta</i> Rea	Russulales, Russulaceae	Mazandaran?	Bahram et al. 2013	HE687092 (env., SH1667972.08FU)
! <i>Russula nigricans</i> Fr.	Russulales, Russulaceae	Mazandaran	Saber 2000a	
! <i>Russula ochroleuca</i> Pers.	Russulales, Russulaceae	Gilan, Golestan	Saber 2000a	
! <i>Russula ochroleucoides</i> Kauffman	Russulales, Russulaceae	Gilan	Saber & Ershad 2004	
● <i>Russula olivacea</i> Pers.	Russulales, Russulaceae	'Hyrcan', Mazandaran	Saber & Ershad 2004, Bahram et al. 2012	FR852106 (env., SH1560122.08FU)
! <i>Russula pectinata</i> Fr.	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
! <i>Russula pectinatoides</i> Peck	Russulales, Russulaceae	Gilan, Golestan	Saber & Ershad 2004	
● <i>Russula persicina</i> Krombh.	Russulales, Russulaceae	Mazandaran?	Bahram et al. 2013	HE687094 (env., SH1509032.08FU)
! <i>Russula perlactea</i> Murrill	Russulales, Russulaceae	Gilan	Saber & Ershad 2004	
! <i>Russula puellaris</i> Fr.	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
! <i>Russula queletii</i> Fr.	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
! <i>Russula risigallina</i> (Batsch) Sacc.	Russulales, Russulaceae	Golestan	Saber & Ershad 2004	
<i>Russula chamaeleontina</i> (Lasch) Fr.				
! <i>Russula romellii</i> Maire	Russulales, Russulaceae	Golestan	Saber & Ershad 2004	
● <i>Russula rosea</i> Pers.	Russulales, Russulaceae	'Hyrcan'	Bahram et al. 2012	FR852107 (env., SH1712188.08FU)
! <i>Russula silvestris</i> (Singer) Reumaux	Russulales, Russulaceae	Mazandaran	Saber & Ershad 2004	
<i>Russula emetica</i> var. <i>silvestris</i> Singer				
● <i>Russula solaris</i> Ferd. & Winge	Russulales, Russulaceae	'Hyrcan'	Bahram et al. 2012	FR852110 (env., SH2136150.08FU)
<i>Russula sororia</i> (Fr.) Romell	Russulales, Russulaceae	East Azerbaijan	Asef 2007b and 2011a	
! <i>Russula torulosa</i> Bres.	Russulales, Russulaceae	Mazandaran	Bahram & Asef 2008b	
● <i>Russula versicolor</i> Jul. Schäff.	Russulales, Russulaceae	'Hyrcan'	Bahram et al. 2012	FR852102 (env., SH2136145.08FU)
● <i>Russula veteriosa</i> Fr.	Russulales, Russulaceae	'Hyrcan'	Bahram et al. 2012	FR852104 (env., SH1905766.08FU)
● <i>Russula vinosopurpurea</i> Jul. Schäff.	Russulales, Russulaceae	'Hyrcan'	Bahram et al. 2012	FR852115 (env., SH1702036.08FU)
! <i>Russula virescens</i> (Schaeff.) Fr.	Russulales, Russulaceae	Gilan, Mazandaran	Saber 2000a, Bahram & Asef 2008b	
<i>Russula aeruginosa</i> (Pers.) Pers.				
! <i>Russula xerampelina</i> (Schaeff.) Fr.	Russulales, Russulaceae	Golestan	Saber & Ershad 2004	

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
<i>Saproamanita codinae</i> (Maire) Redhead, Vizzini, Drehmel & Contu <i>Amanita codinae</i> (Maire) Bertault	Agaricales, Amanitaceae	West Azerbaijan	Saber & Mehravaran 2001	
<i>Sarcomyxa serotina</i> (Pers.) V. Papp <i>Panellus serotinus</i> (Pers.) Kühner	Agaricales, Sarcomyxaaceae	Mazandaran	Saber 1990, Saber 1994b, Saber and Zangeneh 2004	
* <i>Simocybe centunculus</i> (Fr.: Fr.) P. Karst.	Agaricales, Inocybaceae	East Azerbaijan	this study	MT535746
! <i>Sphagnurus paluster</i> (Peck) Redhead & V. Hofst. <i>Collybia thelephora</i> (Cooke & Massee) Sacc., <i>Tephroclybe</i> <i>palustris</i> (Peck) Donk	Agaricales, Lyophyllaceae	Mazandaran	Saber & Zangeneh 2004	
<i>Strobilomyces strobilaceus</i> (Scop.) Berk.	Boletales, Boletaceae	Gilan	Asef 2013	
! <i>Strobilurus esculentus</i> (Wulfen) Singer	Agaricales, Physalacriaceae	Mazandaran	Saber 1998	
! <i>Strobilurus tenacellus</i> (Pers.) Singer	Agaricales, Physalacriaceae	Gilan, Mazandaran	Saber 1998	
! <i>Stropharia aeruginosa</i> (Curtis) Qué.	Agaricales, Strophariaceae	East Azerbaijan	Saber 1991b, Asef & Tavanaei 2004, Asef 2007b	
<i>Stropharia coronilla</i> (Bull.) Qué. <i>Psilocybe coronilla</i> (Bull.) Noordel.	Agaricales, Hymenogastraceae	Kermanshah	Fadavi et al. 2013	
! <i>Stropharia melanosperma</i> (Bull.) Qué.	Agaricales, Strophariaceae	West Azerbaijan	Saber & Mehravaran 2004	
• <i>Suillellus comptus</i> (Simonini) Vizzini, Simonini & Gelardi <i>Boletus comptus</i> Simonini	Boletales, Boletaceae	Ilam, Kermanshah	Seidmohammadi et al. 2017, Yousefshahi et al. 2020	MF278769 (ident. 97%)
* • <i>Suillellus luridus</i> (Schaeff.) Murrill	Boletales, Boletaceae	Lorestan	this study	MT535740
! <i>Suillus bovinus</i> (L.) Roussel	Boletales, Suillaceae	Golestan	Saber 1995d	
• <i>Suillus collinitus</i> (Fr.) Kuntze	Boletales, Suillaceae	East Azerbaijan, Gilan, Mazandaran, Tehran, West Azerbaijan	Saber 1995d, Saber & Zangeneh 2002, Asef 2007b and 2008, Bahram et al. 2013	HE687129 (env., SH1935285.08FU)
• <i>Suillus granulatus</i> (L.) Roussel	Boletales, Suillaceae	East Azerbaijan, Mazandaran?, Tehran	Saber 1995d, Asef 2007b and 2008, Bahram et al. 2013	HE687128 (env., SH2260335.08FU)
• <i>Tricholoma acerbum</i> (Bull.) Qué.	Agaricales, Tricholomataceae	Mazandaran	GenBank Direct Submission	MH628231
! <i>Tricholoma argyraceum</i> (Bull.) Gillet	Agaricales, Tricholomataceae	Tehran	Zangeneh & Maivan 1998	
! <i>Tricholoma caligatum</i> (Viv.) Ricken	Agaricales, Tricholomataceae	Gilan	Saber 2000d	
! <i>Tricholoma equestre</i> (L.) P. Kumm.	Agaricales, Tricholomataceae	East Azerbaijan	Asef 2007b	
<i>Tricholoma flavovirens</i> (Pers.) S. Lundell				
<i>Tricholoma fulvum</i> (Fr.) Bigeard & H. Guill.	Agaricales, Tricholomataceae	Razavi Khorasan	Zokaei 2001	
• <i>Tricholoma lascivum</i> (Fr.) Gillet	Agaricales, Tricholomataceae	Gilan, Golestan, 'Hyrca'	Saber 2000d, Bahram et al. 2012	FR852322 (env., SH1840391.08FU)
! <i>Tricholoma orirubens</i> Qué. <i>Tricholoma guttatum</i> (Schaeff.) P. Kumm.	Agaricales, Tricholomataceae	East Azerbaijan	Asef 2007b	
! <i>Tricholoma psammopus</i> (Kalchbr.) Qué.	Agaricales, Tricholomataceae	Mazandaran	Saber 2000d	
! <i>Tricholoma robustum</i> (Alb. & Schwein.) Ricken	Agaricales, Tricholomataceae	Tehran	Saber 2000d	
• <i>Tricholoma sculpturatum</i> (Fr.) Qué.	Agaricales, Tricholomataceae	Hamadan, Mazandaran?	Bahram et al. 2013, Jadidian et al. 2015	HE687177 (env., SH2569733.08FU)
• <i>Tricholoma cingulatum</i> (Almfelt ex Fr.) Jacobasch	Agaricales, Tricholomataceae	Mazandaran	GenBank Direct Submission	MH620781
• <i>Tricholoma sulphureum</i> (Bull.) P. Kumm.	Agaricales, Tricholomataceae	Golestan, 'Hyrca', Razavi Khorasan	Zokaei 2001, Bahram et al. 2012	FR852325 (env., SH1891870.08FU)

Table 1. Continued.

Species	Order, family	Distribution	References	ITS GenBank/UNITE accession no.
● <i>Tricholoma terreum</i> (Schaeff.) P. Kumm. <i>Tricholoma gausapatum</i> (Fr.) Quél. <i>Tricholoma myomyces</i> (Pers.) J.E. Lange	Agaricales, Tricholomataceae	East Azerbaijan, Mazandaran?, Tehran	Zangeneh & Maivan 1998, Saber 2000d, Asef 2007b, Bahram et al. 2013	HE687176 (env., SH2569728.08FU)
! <i>Tricholoma ustale</i> (Fr.) P. Kumm.	Agaricales, Tricholomataceae	Golestan, Mazandaran	Saber 2000d	
! <i>Tricholoma ustaloides</i> Romagn.	Agaricales, Tricholomataceae	Mazandaran	Saber 2000d	
! <i>Tricholoma vaccinum</i> (Schaeff.) P. Kumm.	Agaricales, Tricholomataceae	Mazandaran	Saber 2000d	
! <i>Tricholomopsis formosa</i> (Murrill) Singer	Agaricales, incertae sedis	Gilan	Saber 2000d	
! <i>Tubaria confragosa</i> (Fr.) Harmaja	Agaricales, Tubariaceae	East Azerbaijan	Asef 2007b	
! <i>Tubaria conspersa</i> (Pers.) Fayod	Agaricales, Tubariaceae	Mazandaran	Saber & Zangeneh 2002	
<i>Tubaria furfuracea</i> (Pers.) Gillet ! <i>Tubaria hiemalis</i> Romagn. ex Bon, <i>Tubaria pellucida</i> (Bull. & Vent.) Sacc.	Agaricales, Tubariaceae	Gilan, Golestan, Tehran, West Azerbaijan	Saber 1990, Saber & Mehravaran 2004	
! <i>Tubaria pallidospora</i> J.E. Lange	Agaricales, Tubariaceae	Tehran	Saber & Zangeneh 2002	
! <i>Tylophilus felleus</i> (Bull.) P. Karst.	Boletales, Boletaceae	Mazandaran	Saber 1995d	
<i>Volvariella iranica</i> (Fallahyan) Szczipka <i>Volvaria iranica</i> Fallahyan	Agaricales, Pluteaceae	Mazandaran	Fallahyan 1973	
! <i>Volvariella bombycina</i> (Schaeff.) Singer	Agaricales, Pluteaceae	Golestan	Saber 1993f	
<i>Volvariella hypopithys</i> (Fr.) Shaffer <i>Volvariella plumulosa</i> (Lasch) Singer	Agaricales, Pluteaceae	Mazandaran, Razavi Khorasan	Saber 2000c, Zokaei 2001	
! <i>Volvariella murinella</i> (Quél.) M.M. Moser ex Dennis, P.D. Orton & Hora	Agaricales, Pluteaceae	Golestan	Saber 2000c	
! <i>Volvariella pusilla</i> (Pers.) Singer	Agaricales, Pluteaceae	?	Saber 1991a	
<i>Volvariella volvacea</i> (Bull.) Singer <i>Volvaria volvacea</i> (Bull.) P. Kumm.	Agaricales, Pluteaceae	Kermanshah, West Azerbaijan	Fallahyan 1973, Fadavi et al. 2015	
<i>Volvopluteus gloiocephalus</i> (DC.) Vizzini, Contu & Justo <i>Volvariella gloiocephala</i> (DC.) Boekhout & Enderle, <i>Volvariella speciosa</i> (Fr.) Singer,	Agaricales, Pluteaceae	East Azerbaijan, Kermanshah	Saber 1991a, Asef 2007b, Fadavi et al. 2015	
! <i>Xerocomellus chrysenteron</i> (Bull.) Šutara <i>Boletus chrysenteron</i> Bull.	Boletales, Boletaceae	Golestan	Saber 1995d	
! <i>Xerocomellus pruinatus</i> (Fr. & Hök) Šutara <i>Boletus pruinatus</i> Fr. & Hök, <i>Xerocomus pruinatus</i> (Fr. & Hök) Quél.	Boletales, Boletaceae	Mazandaran	Saber 1995d	
! <i>Xerocomus moravicus</i> (Vacek) Herink <i>Boletus leonis</i> D.A. Reid	Boletales, Boletaceae	Mazandaran	Saber 1995d	
● <i>Xerocomus subtomentosus</i> (L.) Quél. <i>Xerocomus lanatus</i> (Rostk.) Singer	Boletales, Boletaceae	East Azerbaijan, Golestan, 'Hyrcan'	Saber 1995d, Asef 2007b and 2008, Bahram et al. 2012	FR852284 (env., SH1873179.08FU)
● <i>Xerula pudens</i> (Pers.) Singer <i>Oudemansiella badia</i> M.M. Moser <i>Zhuliangomyces ochraceoluteus</i> (P.D. Orton) Redhead <i>Limacella ochraceolutea</i> P.D. Orton	Agaricales, Physalacriaceae Agaricales, Amanitaceae	Golestan	Saber & Zangeneh 2002, this study Asef & Muradov 2014	MT535743
		East Azerbaijan		

Table 2. Excluded and doubtful taxa. Names in informal references are marked with an exclamation mark (!).

Name in reference	Reference	Notes
!Agaricus erubescens Mont. (<i>Clitocybe erubescens</i> Sacc.)	Saber 2002a	Illegitimate name and also quite unclear taxon (see Index Fungorum).
!Clitocybe dealbata (Sowerby) P. Kumm.	Saber 2002a	Doubtful name.
!Clitocybe ericetorum Quél.	Saber 2002a, Asef 2007b	Doubtful name. No description provided by citing references for clarification.
!Clitocybula lacerata (Scop.) Singer ex Métrod	Saber 1998	Quite unlikely in Iran, associated with old-growth coniferous forests.
!Collybia ocellata (Fr.) P. Kumm.	Asef 2007b	A nomen dubium (Antonín & Noordeloos 2010).
Collybia xylophila (Weinm.) Sacc.	Petrak & Esfandiari 1941, Esfandiari 1946	A nomen dubium (Antonín & Noordeloos 2010).
Cortinarius arvinaceus Fr.	Asef 2007a and 2007b	Likely a nomen dubium (Kibby et al. 2009).
!Cortinarius mucifluus Fr.	Asef 2007b	Unlikely to occur in Iran. Associated with <i>Pinus</i> and <i>Picea</i> , in dry <i>Pinus</i> forests and also in bogs.
Cortinarius pseudonapus (Rob. Henry ex M.M. Moser)	Asef 2007b and 2009a	Unlikely in Iran, associated with <i>Picea</i> forests.
Cortinarius sublubricus (Jul. Schäff. ex M.M. Moser)	Asef 2007b and 2009a	Poorly known, likely a nomen dubium.
Cortinarius subvalidus Rob. Henry (<i>C. saginus</i> (Fr.) Fr.)	Asef 2007b and 2009a	A typical species of natural spruce forests, unlikely in Iran.
!Cortinarius traganus (Fr.) Fr.	Saber 1995f	A typical species of natural spruce and pine forests, unlikely in Iran.
!Entoloma abortivum (Berk. & M.A. Curtis) Donk (<i>Clitopilus abortivus</i> (Berk. & M.A. Curtis) Sacc.)	Saber 1993d	North American species. Very unlikely to occur in Iran.
!Galera conferta (Bolton) P. Kumm.	Saber 1994c	Poorly known taxon without a modern interpretation in Europe.
!Hebeloma versipelle (Fr.) Gillet	Saber 1994c	A nomen dubium.
!Hygrocybe obrussea (Fr.) Wünsche	Saber 1993d	Doubtful name.
!Hygrocybe parvula (Peck) Murrill	Asef 2007b	A North American taxon, unlikely to occur in Iran.
Lactarius insulsus	Khabiri 1968	Authority not mentioned. Affinity ambiguous.
!Mycena alcalina (Fr.) P. Kumm.	Saber 1995h	Doubtful name, more species now.
!Mycena sepia J.E. Lange	Saber 1995h	Identity of this species is unclear; it belongs to the <i>M. filipes</i> / <i>M. metata</i> complex (Aronsen & Læssøe 2016).
!Oudemansiella ephippium (Fr.) M.M. Moser	Saber 1998	Unclear and doubtful name.
!Pleurotus romellianus Pilát	Saber 2000c	Unclear species. Probably not a member of <i>Pleurotus</i> .
Psalliota pratensis Schaeff.	Esfandiari 1946	Unclear name, not <i>Hygrocybe</i> (<i>Cuphophyllus</i>) <i>pratensis</i> as mentioned in MycoBank.
!Psathyrella torpens (Fr.) Konrad & Maubl.	Asef 2007b	Doubtful name. Comparable with <i>P. panaeoloides</i> R. Maire according to Svrček (1961).
Rhizomorpha subcorticalis P. Micheli ex Pers.	Buhse 1860	Only rhizomorphs described in old literature (mostly in 19th cent.). It may represent diverse fungi (e.g. Armillarias).
Russula sardonias Fr.	Khabiri 1968	Uncertain identification. Growing under <i>Pinus</i> especially in acid forests.
Stropharia magnivelaris Peck (<i>Leratiomyces magnivelaris</i> (Peck) Bridge & Spooner)	Fadavi et al. 2013	Unlikely to occur in Iran. Might be <i>Leratiomyces percevalii</i> (Berk. & Broome) Bridge & Spooner instead.
!Xerula furfuracea (Peck) Redhead, Ginns & Shoemaker (<i>Oudemansiella furfuracea</i> (Peck) Zhu L. Yang, G.M. Muell., G. Kost & Rexer)	Saber 1998	North American species. Very unlikely to occur in Iran.

RESULTS

Species data

The annotated list of species of agarics and boletes currently known from Iran is presented in Table 1. Nineteen species are newly recorded from the country, based on vouchered specimens all provided with nrDNA data from basidiomata (Table 3). *In situ* basidiomata photographs of selected species are shown in Fig. 1. Overall, 585 species of agarics and boletes are recorded from Iran, comprising 556 agarics and 29 bolete species (Fig. 2a).

From a taxonomical viewpoint, the Iranian species belong to 147 genera and 34 families, distributed in the six Agaricomycetes orders Agaricales, Russulales, Boletales, Polyporales, Cantharellales, and Hymenochaetales (Fig. 2b). The largest order is Agaricales which encompasses 82% of the species (Fig. 2b). The three largest families are Agaricaceae (59 species), Russulaceae (57 species), and Psathyrellaceae (51 species) (Fig. 3). The family Polyporaceae is represented with seven agaric species in Iran, in the genera *Lentinus*, *Neofavolus* and *Neolentinus* (Fig. 3).

Table 3. DNA sequences from Iranian agarics and boletes newly generated in this study.

Species	Voucher	Locality	GenBank	
			ITS	LSU
<i>Agaricus arvensis</i>	Ghobad-Nejhad 4295	IRAN: Tehran	MT535720	-
<i>Agaricus bitorquis</i>	Ghobad-Nejhad 4284	IRAN: Tehran	MT535709	MT554302
<i>Agaricus iodosmus</i>	Ghobad-Nejhad 4277	IRAN: Tehran	MT535702	MT554295
<i>Agaricus litoralis</i>	Ghobad-Nejhad 4283	IRAN: Semnan	MT535711	MT554304
<i>Agaricus pseudoprattensis</i>	Ghobad-Nejhad 4278	IRAN: Tehran	MT535735	MT554325
<i>Agaricus pseudoprattensis</i>	Ghobad-Nejhad 3071	IRAN: Tehran	MT535748	-
<i>Agrocybe dura</i>	Ghobad-Nejhad 4286	IRAN: Tehran	MT535714	MT554306
<i>Agrocybe dura</i>	Ghobad-Nejhad 4296	IRAN: Tehran	MT535722	MT554312
<i>Agrocybe dura</i>	Ghobad-Nejhad 4299	IRAN: Tehran	MT535724	MT554314
<i>Agrocybe dura</i>	Ghobad-Nejhad 4325	IRAN: Tehran	MT535732	MT554322
<i>Agrocybe praecox</i>	Ghobad-Nejhad 4261	IRAN: Mazandaran	MT535701	MT554294
<i>Amanita lividopallescens</i>	Ghobad-Nejhad 4019	IRAN: Lorestan	MT535691	-
<i>Conocybe apala</i>	Ghobad-Nejhad 4302	IRAN: Tehran	MT535728	MT554318
<i>Coprinellus micaceus</i>	Ghobad-Nejhad 3186	IRAN: Ilam	MT535694	MT554289
<i>Coprinellus micaceus</i>	Ghobad-Nejhad 3278	IRAN: Kohgiluyeh and Boyer-Ahmad	MT535744	MT554334
<i>Coprinopsis</i> sp.	Ghobad-Nejhad 4282	IRAN: Tehran	MT535708	MT554301
<i>Cortinarius hildebrandiae</i>	Ghobad-Nejhad 4202	IRAN: Golestan	MT535704	MT554297
<i>Cortinarius persoonianus</i>	Ghobad-Nejhad 4206	IRAN: Golestan	MT535741	MT554330
<i>Crepidotus subverrucisporus</i>	Ghobad-Nejhad 387	IRAN: East Azerbaijan	MT535745	-
<i>Cuphophyllus virgineus</i>	Ghobad-Nejhad 4191	IRAN: Mazandaran	MT535688	MT554284
<i>Deconica crobula</i>	Ghobad-Nejhad 117	IRAN: East Azerbaijan	MT535747	-
<i>Flammulina velutipes</i>	Ghobad-Nejhad 4305	IRAN: Tehran	MT535715	MT554307
<i>Gymnopilus spectabilis</i>	Ghobad-Nejhad 4207	IRAN: Golestan	MT535703	MT554296
<i>Gymnopus aquosus</i>	Ghobad-Nejhad 4272	IRAN: Mazandaran	MT535700	MT554293
<i>Gymnopus aquosus</i>	Ghobad-Nejhad 4265	IRAN: Mazandaran	MT535699	MT554292
<i>Gymnopus hybridus</i>	Ghobad-Nejhad 3075	IRAN: Ilam	MT535705	MT554299
<i>Gyroporus castaneus</i>	Ghobad-Nejhad 4220	IRAN: Golestan	MT535725	MT554315
<i>Hymenopellis radicata</i>	Ghobad-Nejhad 4204	IRAN: Golestan	MT535683, MT535684	MT554280
<i>Hypholoma fasciculare</i>	Ghobad-Nejhad 4201a	IRAN: Mazandaran	MT535706, MT535707	MT554300
<i>Lactifluus glaucescens</i>	Ghobad-Nejhad 4205	IRAN: Mazandaran	MT535681	MT554278
<i>Lentinus tigrinus</i>	Ghobad-Nejhad 768	IRAN: East Azerbaijan	MT535686	MT554282
<i>Lentinus tigrinus</i>	Ghobad-Nejhad 4326	IRAN: Tehran	MT535692	MT554287
<i>Leucoagaricus leucothites</i>	Ghobad-Nejhad 4276	IRAN: Tehran	MT535696 MT535697	-
<i>Leucoagaricus leucothites</i>	Ghobad-Nejhad 4292	IRAN: Tehran	MT535726	MT554316
<i>Megacollybia platyphylla</i>	Ghobad-Nejhad 4148	IRAN: Mazandaran	MT535698	MT554291
<i>Melanoleuca excisssa</i>	Ghobad-Nejhad 4375	IRAN: East Azerbaijan	MT535742	MT554331
<i>Mycena</i> sp.	Ghobad-Nejhad 134	IRAN: East Azerbaijan	MT535730	MT554320
<i>Mycena</i> sp.	Ghobad-Nejhad 4122	IRAN: Mazandaran	-	MT554298
<i>Mycena xantholeuca</i>	Ghobad-Nejhad 3074	IRAN: Ilam	MT535719	MT554310
<i>Mycena xantholeuca</i>	Ghobad-Nejhad 3077	IRAN: Ilam	MT535733	MT554323
<i>Ossicaulis salomii</i>	Ghobad-Nejhad 4324	IRAN: Tehran	MT535738	MT554327
<i>Pholiota adiposa</i>	Ghobad-Nejhad 600	IRAN: East Azerbaijan	MT535689	MT554285
<i>Pholiota jahnii</i>	Ghobad-Nejhad 757B	IRAN: East Azerbaijan	MT535737	MT554326
<i>Pleurotus cornucopiae</i>	Ghobad-Nejhad 4308	IRAN: Tehran	MT535734	MT554324
<i>Pleurotus eryngii</i>	Ghobad-Nejhad 137	IRAN: East Azerbaijan	MT535679	MT554276
<i>Pleurotus eryngii</i>	Ghobad-Nejhad 1068	IRAN: Ardabil	MT535685	MT554281
<i>Pleurotus ostreatus</i>	Ghobad-Nejhad 759	IRAN: East Azerbaijan	MT535690	MT554286
<i>Pluteus cervinus</i>	Ghobad-Nejhad 4271	IRAN: Mazandaran	MT535687	MT554283
<i>Psathyrella bivelata</i>	Ghobad-Nejhad 4310	IRAN: Tehran	MT535693	MT554288
<i>Psathyrella bivelata</i>	Ghobad-Nejhad 4293	IRAN: Tehran	MT535710	MT554303
<i>Psathyrella bivelata</i>	Ghobad-Nejhad 4303	IRAN: Tehran	MT535727	MT554317
<i>Psathyrella bivelata</i>	Ghobad-Nejhad 71	IRAN: Tehran	MT535729	MT554319
<i>Psathyrella candolleana</i>	Ghobad-Nejhad 4301	IRAN: Tehran	MT535718	MT554309
<i>Psathyrella</i> cf. <i>candolleana</i>	Ghobad-Nejhad 141	IRAN: Tehran	MT535731	MT554321
<i>Psathyrella fatua</i>	Ghobad-Nejhad 3253	IRAN: Kohgiluyeh and Boyer-Ahmad	MT535695	MT554290
<i>Psathyrella hellebosensis</i>	Ghobad-Nejhad 27	IRAN: Semnan	MT535716 MT535717	MT554308
<i>Psathyrella</i> aff. <i>latispora</i>	Ghobad-Nejhad 3322	IRAN: Kohgiluyeh and Boyer-Ahmad	MT535723	MT554313
<i>Pseudoclitocybe cyathiformis</i>	Ghobad-Nejhad 3166	IRAN: Ilam	MT535721	MT554311
<i>Psilocybe</i> sp.	Ghobad-Nejhad 4306	IRAN: Tehran	MT535712, MT535713	MT554305
<i>Rhizomarasmius</i> sp.	Ghobad-Nejhad 4151	IRAN: Mazandaran	MT535736	-
<i>Russula emeticolor</i>	Ghobad-Nejhad 4213	IRAN: Golestan	MT535680	MT554277
<i>Russula emeticolor</i>	Ghobad-Nejhad 4149	IRAN: Mazandaran	MT535682	MT554279
<i>Simocybe centunculus</i>	Ghobad-Nejhad 125	IRAN: East Azerbaijan	MT535746	-
<i>Suillellus luridus</i>	Ghobad-Nejhad 4016	IRAN: Lorestan	MT535740	MT554329
<i>Volvopluteus</i> cf. <i>earlei</i>	Ghobad-Nejhad 4321	IRAN: Tehran	MT535739	MT554328
<i>Xerula pudens</i>	Sohrabi 30619	IRAN: Golestan	MT535743	MT554333



Fig. 1. In situ photographs from basidiomata of selected species newly recorded in this study. **a)** *Amanita lividopallescens*, Ghobad-Nejhad 4018. **b)** *Conocybe apala*, Ghobad-Nejhad 4384. **c)** *Cortinarius hildegardiae*, Ghobad-Nejhad 4202. **d)** *Cortinarius persoonianus*, Ghobad-Nejhad 4206. **e)** *Cuphophyllus virgineus*, Ghobad-Nejhad 4191. **f)** *Gymnopus aquosus*, Ghobad-Nejhad 4272. **g)** *Gymnopus hybridus*, Ghobad-Nejhad 3075. **h)** *Gyroporus castaneus*, Ghobad-Nejhad 4220. **i)** *Mycena xantholeuca*, Ghobad-Nejhad 3074. **j)** *Russula emeticolor*, Ghobad-Nejhad 4213. **k)** *Suillellus luridus*, Ghobad-Nejhad 4016. **l, m)** *Psathyrella bivelata*, Ghobad-Nejhad s.n. Photos: Ghobad-Nejhad.

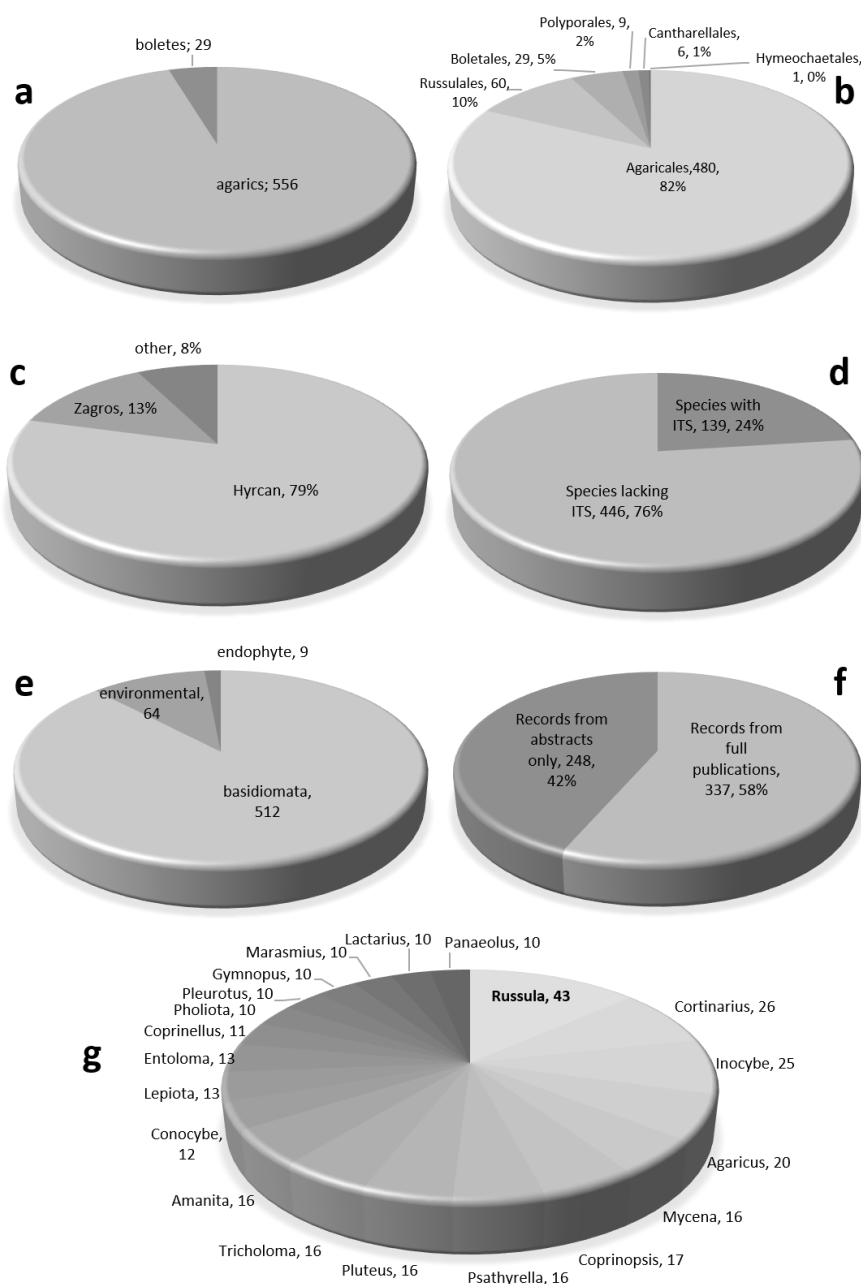


Fig. 2. Figures and facts on agarics and boletes in Iran. **a)** Total number of agaric species vs. bolete species. **b)** Number of species in each order. **c)** Number of species in Hyrcan vs. Zagros regions; ‘other’ means not found in Hyrcan nor in Zagros, but mainly found in central Iran. **d)** Number of species with and without nrITS sequence. **e)** The source of recorded species being from basidiomata, from environmental samples, or retrieved as plant endophytes. **f)** The number of species recorded solely in congress abstracts. **g).** The Iranian genera with more than 10 species.

Out of a total of 147 genera in Iran, 20 genera have $\geq$ ten species (Fig. 2g). The three most species-rich genera in Iran are *Russula* (43 species), *Cortinarius* (26 species), and *Inocybe* (25 species) (Fig. 2g); these genera are ectomycorrhizal. Excluded and doubtful taxa are presented in Table 2. Based on this, 28 species are excluded from the Iranian mycobiota (Table 2).

Considering the geographic distribution of the species, we summarized data on species occurring in the Hyrcan (northern Iran), Zagros (western Iran), and other regions in Iran (Fig. 2c). Based on our analyses, the majority (79%) of agaric and bolete species

recorded from Iran reside in the narrow, small area of Hyrcanian forests (Fig. 2c). Here, Mazandaran province is at the top, being the most species-rich province in the country (244 species), followed by Gilan (143 species) and Golestan provinces (134 species) (Fig. 4). The Zagros region harbors only 13% of the species (Fig. 2c). In total, 8% of the species have not been recorded in Hyrcan/Zagros forests, but were found mainly in central Iran. Tehran province is shown to have 65 species, while no species is yet known from Yazd province. For 89 species, distribution data is

lacking (Fig. 4). Lists of species for each province of the country are provided in Table 4.

Regarding the situation with the literature records, our analyses demonstrate that as much as 42% of records in Iran arise merely from single abstracts presented in conferences (Fig. 2f, species marked with ! in the Table 1). This means that such species have appeared in congress abstract only, with no subsequent

evidence to support them; most of these records lack sufficient characterization, species name authority, or vouchers. For many of these, modern interpretation of the names was difficult, if not impossible. We were not able to trace the vouchers to re-examine them. Therefore, it is recommended that these records be considered tentatively for the time being, until more data become available about their identity.

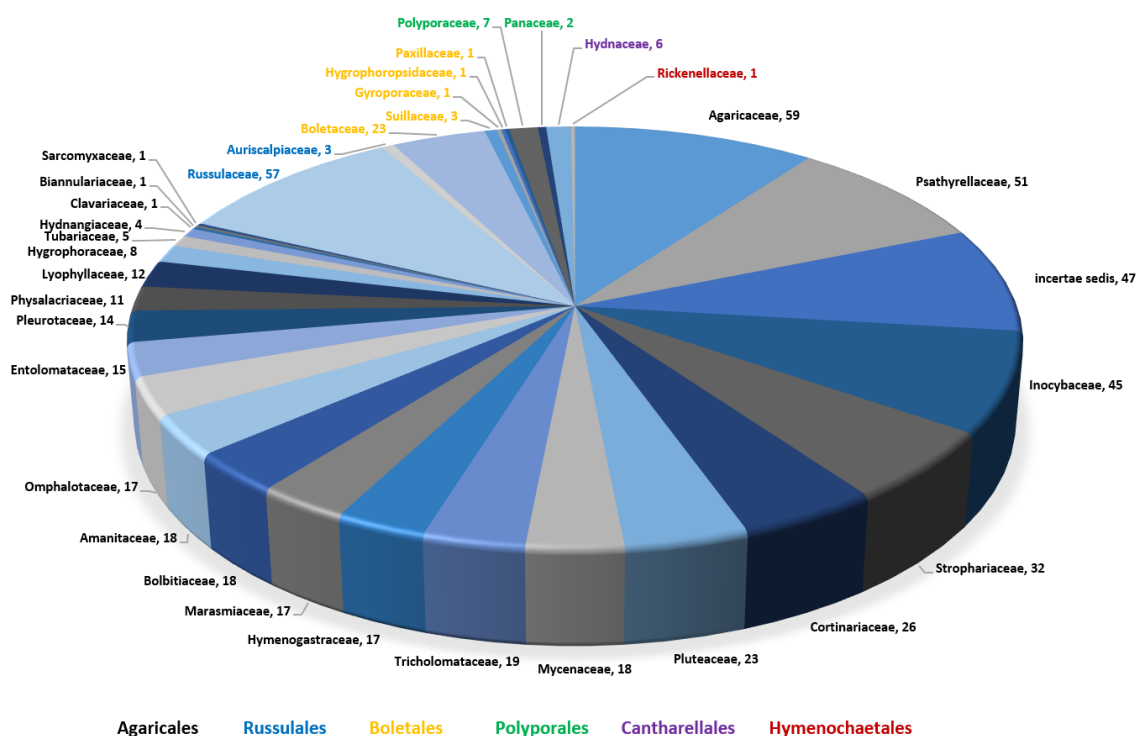


Fig. 3. Families of agarics and boletes in Iran and the number of species per family. Family color fonts correspond to the color of the order names in the lower side of the chart.

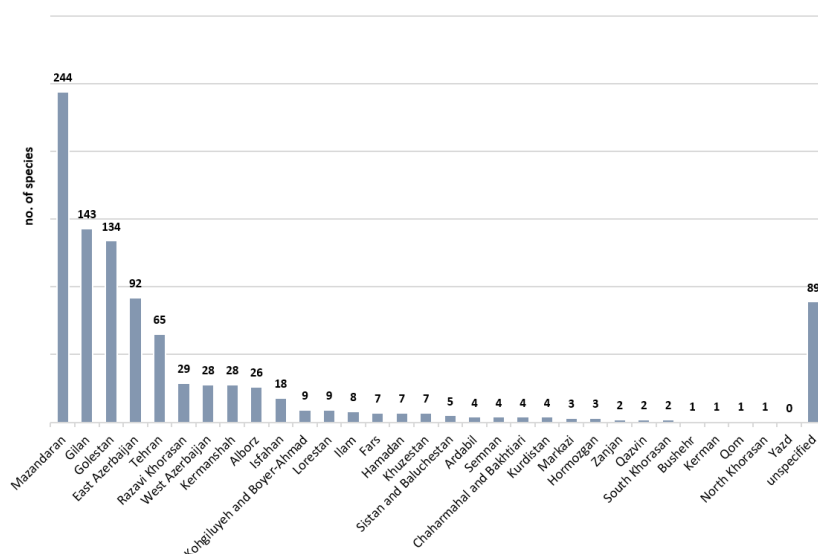


Fig. 4. Number of agaric and bolete species in each province of Iran. 89 species lack information on province distribution. (Full list of species for each province is available in Table 4).

Table 4. Lists of agarics and boletes for each province of Iran. For more details see Table 1 and the text.

Province	List of species
Alborz	<i>Agaricus arvensis</i> , <i>Agaricus bitorquis</i> , <i>Agaricus litoralis</i> , <i>Armillaria lutea</i> , <i>Armillaria mellea</i> , <i>Conocybe albipes</i> , <i>!Conocybe subovalis</i> , <i>Coprinellus disseminatus</i> , <i>Coprinellus micaceus</i> , <i>Coprinellus subimpatiens</i> , <i>Coprinopsis atramentaria</i> , <i>Coprinopsis cinerea</i> , <i>Coprinopsis ephemeroides</i> , <i>Coprinopsis lagopus</i> , <i>Coprinopsis nivea</i> , <i>Coprinopsis picacea</i> , <i>Flammulina velutipes</i> , <i>Gymnopus fusipes</i> , <i>Lentinus lepideus</i> , <i>Lentinus tigrinus</i> , <i>Lepiota cristata</i> , <i>Pholiota adiposa</i> , <i>Pholiota gummosa</i> , <i>Pholiota populnea</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus ostreatus</i> .
Ardabil	<i>Agaricus bisporus</i> , <i>Agaricus campestris</i> , <i>!Entoloma vernum</i> , <i>Pleurotus eryngii</i> .
Bushehr	<i>Agaricus nevoi</i> .
Chaharmahal and Bakhtiari	<i>Agaricus bitorquis</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus fossulatus</i> , <i>Pleurotus nebrodensis</i> .
East Azerbaijan	<i>Agaricus arvensis</i> , <i>Agaricus bisporus</i> , <i>Agaricus bitorquis</i> , <i>Agaricus campestris</i> , <i>Agaricus iododermis</i> , <i>Agaricus litoralis</i> , <i>Agrocybe praecox</i> , <i>!Agrocybe tabacina</i> , <i>Amanita pantherina</i> , <i>Amanita vaginata</i> , <i>Ampulloclitocybe clavipes</i> , <i>Armillaria cepistipes</i> , <i>Armillaria lutea</i> , <i>Armillaria mellea</i> , <i>Boletus edulis</i> , <i>Butyriboletus fechtneri</i> , <i>Chlorophyllum rhacodes</i> , <i>!Clitocybe nebularis</i> , <i>Clitocybe rufololulacea</i> , <i>!Coprinellus truncorum</i> , <i>Coprinopsis nivea</i> , <i>Coprinopsis picacea</i> , <i>Cortinarius causticus</i> , <i>Cortinarius erumpens</i> , <i>Cortinarius fluryi</i> , <i>Cortinarius paracephalix</i> , <i>Cortinarius pluviorum</i> , <i>!Cortinarius valgi</i> , <i>Cortinarius vespertinus</i> , <i>Crepidotus cesatii</i> , <i>Crepidotus subverrucisporus</i> , <i>Cyanoboletus pulverulentus</i> , <i>Deconica crobula</i> , <i>Entoloma griseoluridum</i> , <i>Entoloma niphoides</i> , <i>Flammulina velutipes</i> , <i>!Gymnopus erythropus</i> , <i>!Gymnopus foetidus</i> , <i>!Hebeloma hiemale</i> , <i>!Hodophilus hymenoccephalus</i> , <i>!Hygrophorus mesotephros</i> , <i>Hymenopellis radicata</i> , <i>Hypholoma fasciculare</i> , <i>!Hypholoma radicosum</i> , <i>Infundibulicybe geotropa</i> , <i>Infundibulicybe trulliformis</i> , <i>!Inocybe leptocystis</i> , <i>Laccaria laccata</i> , <i>Lactarius serifluus</i> , <i>Lactifluus volemus</i> , <i>Leccinellum pseudoscabrum</i> , <i>Lentinus tigrinus</i> , <i>Lepiota castanea</i> , <i>Lepiota cristata</i> , <i>!Lepista nuda</i> , <i>Leucocybe houghtonii</i> , <i>!Leucopaxillus giganteus</i> , <i>!Macrolepiota mastoidea</i> , <i>Macrolepiota procera</i> , <i>Melanoleuca excissa</i> , <i>Mycena acicula</i> , <i>Mycena clavicularis</i> , <i>Neoboletus luridiformis</i> , <i>!Panaeolus fimicola</i> , <i>Panaeolus papilionaceus</i> , <i>Paralepista flaccida</i> , <i>!Parasola leiocephala</i> , <i>!Paraxerula causesi</i> , <i>Paxillus involutus</i> , <i>Pholiota adiposa</i> , <i>Pholiota jahnii</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus ostreatus</i> , <i>Pluteus cervinus</i> , <i>Pseudosperma perlatum</i> , <i>Pseudosperma rimosum</i> , <i>!Russula cyanoxantha</i> , <i>Russula delica</i> , <i>Russula emetica</i> , <i>Russula lilacea</i> , <i>Russula sororia</i> , <i>Simocybe centunculus</i> , <i>!Stropharia aeruginosa</i> , <i>Suillus collinitus</i> , <i>Suillus granulatus</i> , <i>!Tricholoma equestre</i> , <i>!Tricholoma orirubens</i> , <i>Tricholoma terreum</i> , <i>Tubaria confragosa</i> , <i>Volvopluteus gloiocephalus</i> , <i>Xerocomus subtomentosus</i> , <i>Zhuliangomyces ochraceolutes</i> .
Fars	<i>Agaricus bitorquis</i> , <i>Agaricus nevoi</i> , <i>Coprinellus angulatus</i> , <i>Montagnea arenaria</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus fossulatus</i> , <i>Psathyrella candolleana</i> .
Gilan	<i>Agaricus arvensis</i> , <i>Agaricus iranicus</i> , <i>Agaricus moelleri</i> , <i>!Agaricus pseudolutosus</i> , <i>Agaricus subrufescens</i> , <i>Agaricus xanthodermis</i> , <i>Agrocybe dura</i> , <i>!Agrocybe paludosa</i> , <i>Agrocybe praecox</i> , <i>!Agrocybe vervacti</i> , <i>!Alnicola escharioides</i> , <i>Amanita phalloides</i> , <i>Amanita rubescens</i> , <i>Amanita verna</i> , <i>Armillaria mellea</i> , <i>!Atheniella flavoalba</i> , <i>!Calocybe chrysenteron</i> , <i>!Calocybe ionides</i> , <i>Cantharellus ferruginascens</i> , <i>!Clitocybe barbulorum</i> , <i>!Clitocybe nebularis</i> , <i>!Clitocybe vibecina</i> , <i>!Clitopaxillus alexandri</i> , <i>Clitopilus prunulus</i> , <i>!Collybia tuberosa</i> , <i>!Conocybe rickenii</i> , <i>Coprinopsis atramentaria</i> , <i>!Cortinarius cinnamomeus</i> , <i>Craterellus cinereus</i> , <i>Craterellus cornucopioides</i> , <i>Crepidotus applanatus</i> , <i>Crepidotus caspari</i> , <i>Crepidotus mollis</i> , <i>Cyanoboletus pulverulentus</i> , <i>Cycloclitocybe cylindracea</i> , <i>!Entoloma hirtipes</i> , <i>!Entoloma rhodopolium</i> , <i>!Entoloma sericellum</i> , <i>!Flammulaster gracilis</i> , <i>Flammulina velutipes</i> , <i>!Gymnopus androsaceus</i> , <i>!Gymnopus brassicolens</i> , <i>Gymnopus dryophilus</i> , <i>!Gymnopus erythropus</i> , <i>!Gymnopus foetidus</i> , <i>Gymnopus fusipes</i> , <i>!Gymnopus inodorus</i> , <i>!Gymnopus terginus</i> , <i>Hohenbuehelia atrocoerulea</i> , <i>Hohenbuehelia petaloides</i> , <i>Hygrophorus aurantiaca</i> , <i>!Hygrophorus eburneus</i> , <i>Hygrophorus persoonii</i> , <i>Hymenopellis radicata</i> , <i>Hypholoma fasciculare</i> , <i>!Hypholoma radicosum</i> , <i>!Hypholoma subericaeum</i> , <i>Inocybe asterospora</i> , <i>Inocybe dulcamara</i> , <i>Inocybe lilacina</i> , <i>Inocybe paludinella</i> , <i>Inosperma cookei</i> , <i>Inosperma maculatum</i> , <i>Laccaria amethystina</i> , <i>Laccaria bicolor</i> , <i>Lactarius deliciosus</i> , <i>Lactarius scrobiculatus</i> , <i>Lactarius subdulcis</i> , <i>Lactifluus piperatus</i> , <i>Lactifluus vellereus</i> , <i>!Leccinum vesipelle</i> , <i>Lentinellus cochleatus</i> , <i>Lentinus cyathiformis</i> , <i>Lentinus strigosus</i> , <i>Lentinus tigrinus</i> , <i>Lepiota brunneoincarnata</i> , <i>Lepiota cristata</i> , <i>!Lepista nuda</i> , <i>!Leucoagaricus nymphaeum</i> , <i>Marasmiellus candidus</i> , <i>!Marasmiellus confluens</i> , <i>!Marasmiellus peronatus</i> , <i>!Marasmiellus ramealis</i> , <i>!Marasmius atrorubens</i> , <i>!Marasmius corrugatifomis</i> , <i>!Marasmius epiphyllus</i> , <i>!Marasmius favoloides</i> , <i>!Marasmius ferrugineus</i> , <i>!Marasmius haematocephalus</i> , <i>!Marasmius oreades</i> , <i>Marasmius rotula</i> , <i>!Marasmius rubroflavus</i> , <i>Megacollybia platyphylla</i> , <i>Montagnea haussknechtii</i> , <i>Mycena crocata</i> , <i>!Mycena filopes</i> , <i>!Mycena galericulata</i> , <i>Mycena haematopus</i> , <i>!Mycena inclinata</i> , <i>!Mycena pearsoniana</i> , <i>!Mycena pelianthina</i> , <i>!Mycena polygramma</i> , <i>!Mycena pura</i> , <i>Mycetinis alliaceus</i> , <i>!Mycetinis scorodoni</i> , <i>Neofavolus suavissimus</i> , <i>Neolentinus adhaerens</i> , <i>!Omphalina pyxidate</i> , <i>Omphalotus olearius</i> , <i>Panaeolus campanulatus</i> , <i>Panellus stipticus</i> , <i>Panus conchatus</i> , <i>!Paragymnopus perforans</i> , <i>Paxillus involutus</i> , <i>Phloeomana speirea</i> , <i>Pholiota gummosa</i> , <i>Pholiota populnea</i> , <i>!Pholiotina striipes</i> , <i>!Pholiotina vexans</i> , <i>Pleurotellus chioneus</i> , <i>Pleurotus djamor</i> , <i>Pleurotus ostreatus</i> , <i>Pleurotus pulmonarius</i> , <i>!Pluteus aurantiorugosus</i> , <i>!Pluteus depauperatus</i> , <i>Pseudoclitocybe cyathiformis</i> , <i>Rhodocollybia maculata</i> , <i>Russula atropurpurea</i> , <i>!Russula atrorubens</i> , <i>!Russula claroflava</i> , <i>!Russula ionochlora</i> , <i>!Russula ochroleuca</i> , <i>!Russula ochroleucoides</i> , <i>!Russula pectinatoides</i> , <i>!Russula perlactea</i> , <i>!Russula virescens</i> , <i>Strobilomyces strobilaceus</i> , <i>!Strobilurus tenacellus</i> , <i>Suillus collinitus</i> , <i>!Tricholoma caligatum</i> , <i>Tricholoma lascivum</i> , <i>!Tricholomopsis formosa</i> , <i>Tubaria furfuracea</i> .
Hamadan	<i>Agaricus arvensis</i> , <i>Conocybe leucopus</i> , <i>Mallochybe terrigena</i> , <i>Pleurotus ostreatus</i> , <i>Psathyrella clivensis</i> , <i>Psathyrella tephrophylla</i> , <i>Tricholoma scalpturatum</i> .

Table 4. Continued.

Province	List of species
Golestan	<i>Agaricus arvensis</i> , ! <i>Agaricus bresadolanus</i> , ! <i>Agaricus brunneolus</i> , <i>Agaricus campestris</i> , ! <i>Agaricus langei</i> , <i>Agaricus moelleri</i> , <i>Agaricus xanthodermus</i> , ! <i>Agrocybe acericola</i> , <i>Agrocybe dura</i> , <i>Agrocybe praecox</i> , <i>Amanita excelsa</i> , <i>Amanita pantherina</i> , <i>Amanita vaginata</i> , <i>Ampulloclitocybe clavipes</i> , <i>Armillaria lutea</i> , <i>Armillaria mellea</i> , ! <i>Arrhenia griseopallida</i> , <i>Battarrea stevenii</i> , <i>Bolbitius reticulatus</i> , ! <i>Bolbitius titubans</i> , ! <i>Boletus aestivalis</i> , <i>Cantharellus alborufescens</i> , <i>Cantharellus cibarius</i> , <i>Cantharellus ferruginascens</i> , <i>Chalciporus piperatus</i> , <i>Clitocybe angustissima</i> , <i>Clitopilus prunulus</i> , <i>Clitopilus scyphoides</i> , <i>Conocybe albipes</i> , <i>Conocybe juniana</i> , ! <i>Conocybe ochracea</i> , <i>Cortinarius hildegardiae</i> , <i>Cortinarius persoonianus</i> , <i>Crepidotus applanatus</i> , <i>Crepidotus casparyi</i> , <i>Crepidotus crocophyllus</i> , <i>Crepidotus mollis</i> , ! <i>Crinipellis scabella</i> , <i>Cyclocybe cylindracea</i> , <i>Cystoderma aureum</i> , ! <i>Dermoloma cuneifolium</i> , <i>Echinoderma asperum</i> , <i>Entoloma incanum</i> , ! <i>Entoloma majaloides</i> , ! <i>Entoloma mammosum</i> , <i>Entoloma sinuatum</i> , <i>Flammulaster ferrugineus</i> , <i>Galerina marginata</i> , <i>Gymnopilus spectabilis</i> , ! <i>Gymnopus androsaceus</i> , <i>Gymnopus dryophilus</i> , ! <i>Gymnopus inodorus</i> , <i>Gyroporus castaneus</i> , <i>Hohenbuehelia auriscalpium</i> , <i>Hymenopellis radicata</i> , <i>Hypholoma fasciculare</i> , <i>Hypsizygus ulmarius</i> , <i>Inocybe erubescens</i> , <i>Inocybe lilacina</i> , <i>Inocybe praetervisa</i> , ! <i>Laccaria bicolor</i> , <i>Lactarius scrobiculatus</i> , <i>Lactifluus piperatus</i> , <i>Lactifluus volemus</i> , ! <i>Leccinum scabrum</i> , <i>Lentinellus ursinus</i> , <i>Lentinus vulpinus</i> , <i>Lentinus sajor-caju</i> , <i>Lentinus strigosus</i> , <i>Lepiota echinella</i> , ! <i>Lepista irina</i> , <i>Marasmiellus candidus</i> , ! <i>Marasmiellus ramealis</i> , <i>Marasmius rotula</i> , <i>Megacollybia platyphylla</i> , ! <i>Melanoleuca subpulverulenta</i> , <i>Mycena crocata</i> , ! <i>Mycena filopes</i> , ! <i>Mycena galericulata</i> , <i>Mycena haematopus</i> , ! <i>Mycena inclinata</i> , ! <i>Mycena metata</i> , <i>Mycetinis alliaceus</i> , ! <i>Omphaliaster asterosporus</i> , <i>Omphalotus olearius</i> , ! <i>Panaeolus plantaginiformis</i> , <i>Panellus stipticus</i> , ! <i>Paragymnopus perforans</i> , <i>Paxillus involutus</i> , ! <i>Phellorinia herculeana</i> , <i>Phloeomana speirea</i> , <i>Pholiota adiposa</i> , <i>Pholiota squarrosa</i> , <i>Pleurotellus chioneus</i> , <i>Pleurotus cornucopiae</i> , <i>Pleurotus ostreatus</i> , <i>Pleurotus pulmonarius</i> , <i>Pluteus cervinus</i> , <i>Pluteus chrysophaeus</i> , ! <i>Pluteus depauperatus</i> , ! <i>Pluteus punctipes</i> , <i>Pluteus romellii</i> , <i>Pluteus salicinus</i> , <i>Pluteus thomsonii</i> , <i>Pogonoloma macrocephalum</i> , ! <i>Psathyrella obtusata</i> , <i>Pseudoclitocybe cyathiformis</i> , <i>Pseudosperma perlatum</i> , <i>Rhodotus palmatus</i> , ! <i>Rubroboletus satanas</i> , ! <i>Russula alutacea</i> , ! <i>Russula carminipes</i> , ! <i>Russula cyanoxantha</i> , <i>Russula emetica</i> , <i>Russula emeticolor</i> , ! <i>Russula graveolens</i> , <i>Russula heterophylla</i> , <i>Russula integra</i> , ! <i>Russula ochroleuca</i> , ! <i>Russula pectinatoides</i> , ! <i>Russula risigallina</i> , ! <i>Russula romellii</i> , ! <i>Russula xerampelina</i> , ! <i>Russula bovinus</i> , <i>Tricholoma lascivum</i> , <i>Tricholoma sulphureum</i> , ! <i>Tricholoma ustale</i> , <i>Tubaria furfuracea</i> , ! <i>Volvariella bombycina</i> , ! <i>Volvariella murinella</i> , ! <i>Xerocomellus chrysenteron</i> , <i>Xerocomus subtomentosus</i> , <i>Xerula pudens</i> .
Hormozgan	<i>Agaricus bisporus</i> , <i>Agaricus devoniensis</i> , <i>Agaricus nevoi</i> .
Ilam	<i>Amanita lividopallescens</i> , <i>Coprinellus micaceus</i> , <i>Gymnopus hybridus</i> , <i>Macrocybe gigantea</i> , <i>Mycena xantholeuca</i> , <i>Pseudoclitocybe cyathiformis</i> , <i>Pseudosperma rimosum</i> , <i>Suillellus comptus</i> .
Isfahan	<i>Agaricus bitorquis</i> , <i>Armillaria mellea</i> , <i>Coprinellus disseminatus</i> , <i>Coprinellus micaceus</i> , <i>Coprinopsis atramentaria</i> , ! <i>Coprinopsis martini</i> , <i>Flammulina velutipes</i> , ! <i>Inocybe corydalina</i> , <i>Inocybe hirtella</i> , <i>Inosperma bongardii</i> , <i>Lactifluus piperatus</i> (?), <i>Lepiota cristata</i> , ! <i>Lepiota lilacea</i> , <i>Leucoagaricus leucothites</i> , ! <i>Parasola miser</i> , <i>Pholiota adiposa</i> , <i>Pleurotus eryngii</i> , <i>Pluteus romellii</i> .
Kerman	<i>Montagnea arenaria</i> .
Kermanshah	<i>Agaricus devoniensis</i> , <i>Agaricus nevoi</i> , <i>Agrocybe dura</i> , <i>Agrocybe ochracea</i> , ! <i>Agrocybe vervacti</i> , <i>Conocybe albipes</i> , <i>Conocybe dunensis</i> , <i>Coprinopsis atramentaria</i> , <i>Coprinopsis urticicola</i> , <i>Coprinus comatus</i> , <i>Coprinus sterquilinus</i> , <i>Entoloma griseorubellum</i> , <i>Inocybe subnudipes</i> , <i>Inocybe terrifera</i> , <i>Lentinus tigrinus</i> , <i>Leucoagaricus carneifolius</i> , ! <i>Panaeolus olivaceus</i> , ! <i>Pholiota highlandensis</i> , <i>Pleurotus ostreatus</i> , <i>Pleurotus pulmonarius</i> , <i>Pluteus cinereofuscus</i> , <i>Pluteus nanus</i> , <i>Pogonoloma macrocephalum</i> , <i>Psilocybe atrobrunnea</i> , <i>Stropharia coronilla</i> , <i>Suillellus comptus</i> , <i>Volvariella volvacea</i> , <i>Volvopluteus gloiocephalus</i> .
Khuzestan	<i>Agaricus bisporus</i> , <i>Agaricus bitorquis</i> , <i>Agaricus nevoi</i> , <i>Armillaria mellea</i> , <i>Lepiota anthomyces</i> , <i>Lepiota metulisporea</i> , <i>Leucoagaricus serenus</i> .
Kohgiluyeh and Boyer-Ahmad	<i>Agaricus bitorquis</i> , <i>Agaricus nevoi</i> , <i>Coprinellus micaceus</i> , ! <i>Hemileccinum impolatum</i> , <i>Lentinus tigrinus</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus fossulatus</i> , <i>Pleurotus nebrodensis</i> , <i>Psathyrella fatua</i> .
Kurdistan	<i>Agaricus bisporus</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus fossulatus</i> , <i>Pleurotus nebrodensis</i> .
Lorestan	<i>Agaricus bisporus</i> , <i>Amanita umbrinolutea</i> , <i>Amanita lividopallescens</i> , <i>Coprinopsis picacea</i> , <i>Lentinus tigrinus</i> , ! <i>Leratiomyces squamosus</i> , ! <i>Melanoleuca cognata</i> , <i>Pleurotus eryngii</i> , <i>Suillellus luridus</i> .
Markazi	<i>Agaricus bisporus</i> , <i>Agaricus bitorquis</i> , <i>Armillaria mellea</i> .
North Khorasan	<i>Pleurotus ostreatus</i> .
Qazvin	<i>Agrocybe dura</i> , <i>Armillaria mellea</i> .
Qom	<i>Montagnea arenaria</i> .
Razavi Khorasan	<i>Agaricus bitorquis</i> , <i>Armillaria mellea</i> , <i>Clitocybe rufuloalutacea</i> , <i>Conocybe albipes</i> , <i>Coprinellus disseminatus</i> , <i>Coprinellus micaceus</i> , <i>Coprinopsis atramentaria</i> , <i>Coprinopsis picacea</i> , <i>Coprinus comatus</i> , <i>Cyclocybe cylindracea</i> , <i>Deconica crobula</i> , <i>Entoloma incanum</i> , <i>Flammulina velutipes</i> , <i>Hypholoma fasciculare</i> , <i>Lepiota cristata</i> , <i>Lepista saeva</i> , <i>Macrolepiota procera</i> , <i>Montagnea arenaria</i> , <i>Mycena galopus</i> , ! <i>Omphalina mutila</i> , <i>Panaeolus rickenii</i> , <i>Parasola plicatilis</i> , <i>Pholiota adiposa</i> , <i>Pleurotus ostreatus</i> , <i>Psathyrella candolleana</i> , ! <i>Psathyrella obtusata</i> , <i>Tricholoma fulvum</i> , <i>Tricholoma sulphureum</i> , <i>Volvariella hypophitys</i> .
Semnan	<i>Agaricus litoralis</i> , <i>Armillaria mellea</i> , <i>Montagnea arenaria</i> , <i>Psathyrella hellebosensis</i> .
Sistan and Baluchestan	! <i>Conocybe tenera</i> , <i>Coprinellus disseminatus</i> , <i>Montagnea arenaria</i> , <i>Neofavolus suavissimus</i> , <i>Psathyrella candolleana</i> .
South Khorasan	<i>Pleurotus eryngii</i> , <i>Psathyrella obtusata</i> .

Table 4. Continued.

Province	List of species
Mazandaran	<i>Cortinarius diasemospermus</i> (?), <i>Cortinarius parvannulatus</i> (?), <i>Cortinarius vernus</i> (?), <i>Inocybe amethystine</i> (?), <i>Inocybe castaneicolor</i> (?), <i>Inocybe decemgibbosa</i> (?), <i>Inocybe flocculosa</i> (?), <i>Inocybe godeyi</i> (?), <i>Inocybe langei</i> (?), <i>Inocybe mixtilis</i> (?), <i>Russula luteotacta</i> (?), <i>Russula persicina</i> (?), <i>Suillus granulatus</i> (?), <i>Tricholoma scalpturatum</i> (?), <i>Tricholoma terreum</i> (?), <i>Agaricus arvensis</i>, <i>Agaricus campestris</i>, <i>Agaricus litoralis</i>, <i>Agaricus moelleri</i>, <i>Agaricus phaeolepidotus</i>, <i>Agrocybe praecox</i>, <i>Amanita atkinsoniana</i>, <i>Amanita battarrae</i>, <i>Amanita caesarea</i>, <i>Amanita ceciliae</i>, <i>Amanita crocea</i>, <i>Amanita eliae</i>, <i>Amanita excelsa</i>, <i>Amanita gemmata</i>, <i>Amanita pantherina</i>, <i>Amanita phalloides</i>, <i>Amanita strobiliformis</i>, <i>Amanita vaginata</i>, <i>Amanita verna</i>, <i>Ampulloclitocybe clavipes</i>, <i>Armillaria borealis</i>, <i>Armillaria lutea</i>, <i>Armillaria mellea</i>, <i>Asterophora lycoperdoides</i>, <i>Aureoboletus gentilis</i>, <i>Baeospora myosura</i>, <i>Bolbitius reticulatus</i>, <i>Calocybe persicolor</i>, <i>Cantharellus alborufescens</i>, <i>Cantharellus ferruginascens</i>, <i>Clitocybe metachroa</i>, <i>Clitocybe nebularis</i>, <i>Clitocybe phyllophila</i>, <i>Clitopilus prunulus</i>, <i>Conocybe macrocephala</i>, <i>Conocybe microspora</i>, <i>Conocybe pilosella</i>, <i>Contumyces rosellus</i>, <i>Coprinellus disseminatus</i>, <i>Coprinellus micaceus</i>, <i>Coprinellus radians</i>, <i>Coprinopsis atramentaria</i>, <i>Coprinopsis brunneofibrillosa</i>, <i>Coprinopsis cinerea</i>, <i>Coprinopsis lagopus</i>, <i>Coprinopsis urticicola</i>, <i>Coprinus comatus</i>, <i>Cortinarius decipiens</i>, <i>Cortinarius vibratilis</i>, <i>Cortinarius violaceus</i>, <i>Craterellus cinereus</i>, <i>Craterellus cornucopioideus</i>, <i>Crepidotus applanatus</i>, <i>Crepidotus caspari</i>, <i>Crepidotus cesatii</i>, <i>Crepidotus crocophyllus</i>, <i>Crepidotus mollis</i>, <i>Cuphophyllus virgineus</i>, <i>Cycloclitocybe cylindracea</i>, <i>Cystoderma aureum</i>, <i>Delicatula integrella</i>, <i>Echinoderma asperum</i>, <i>Entoloma clypeatum</i>, <i>Entoloma rhodopolium</i>, <i>Entoloma sinuatum</i>, <i>Flammulaster erinaceellus</i>, <i>Flammulaster gracilis</i>, <i>Flammulina velutipes</i>, <i>Galerina marginata</i>, <i>Gymnopus androsaceus</i>, <i>Gymnopus aquosus</i>, <i>Gymnopus dryophilus</i>, <i>Gymnopus erythropus</i>, <i>Gymnopus foetidus</i>, <i>Gymnopus inodorus</i>, <i>Gymnopus terginus</i>, <i>Hemimycena cucullata</i>, <i>Hohenbuehelia auriscalpium</i>, <i>Hohenbuehelia petaloides</i>, <i>Hydropus marginellus</i>, <i>Hygrocybe acutoconica</i>, <i>Hygrocybe chlorophana</i>, <i>Hygrophoropsis aurantiaca</i>, <i>Hygrophorus persoonii</i>, <i>Hymenopellis radicata</i>, <i>Hypholoma capnoides</i>, <i>Hypholoma fasciculare</i>, <i>Hypholoma lateritium</i>, <i>Infundibulicybe gibba</i>, <i>Inocybe asterospora</i>, <i>Inocybe dulcamara</i>, <i>Inocybe geophylla</i>, <i>Inocybe lilacina</i>, <i>Inocybe napipes</i>, <i>Inocybe tabacina</i>, <i>Inosperma adaequatum</i>, <i>Inosperma bongardii</i>, <i>Inosperma cookei</i>, <i>Inosperma maculatum</i>, <i>Laccaria bicolor</i>, <i>Laccaria laccata</i>, <i>Laccaria tortilis</i>, <i>Lactaria lacrymabunda</i>, <i>Lactarius rubrocinctus</i>, <i>Lactarius subdulcis</i>, <i>Lactarius tabidus</i>, <i>Lactifluus glaucescens</i>, <i>Lactifluus vellereus</i>, <i>Leccinellum pseudoscabrum</i>, <i>Lentinus lepideus</i>, <i>Lentinus strigosus</i>, <i>Lentinus tigrinus</i>, <i>Lepiota castanea</i>, <i>Lepiota leprica</i>, <i>Lepiota subincarnata</i>, <i>Lepista saeva</i>, <i>Leucoagaricus americanus</i>, <i>Leucoagaricus badhamii</i>, <i>Leucoagaricus holospilotus</i>, <i>Leucoagaricus leucothites</i>, <i>Leucocoprinus magnusianus</i>, <i>Leucocybe candicans</i>, <i>Leucopaxillus compactus</i>, <i>Leucopaxillus pinicola</i>, <i>Lyophyllum atratum</i>, <i>Lyophyllum baeospermum</i>, <i>Macrolepiota permixta</i>, <i>Macrolepiota procera</i>, <i>Marasmiellus candidus</i>, <i>Marasmiellus peronatus</i>, <i>Marasmiellus ramealis</i>, <i>Marasmius atrorubens</i>, <i>Marasmius corrugatiformis</i>, <i>Marasmius favoloides</i>, <i>Marasmius ferrugineus</i>, <i>Marasmius haematocephalus</i>, <i>Marasmius rotula</i>, <i>Marasmius rubroflavus</i>, <i>Marasmius wynneae</i>, <i>Megacollybia platyphylla</i>, <i>Mycena crocata</i>, <i>Mycena galericulata</i>, <i>Mycena haematopus</i>, <i>Mycena inclinata</i>, <i>Mycena rapiolens</i>, <i>Mycena sanguinolenta</i>, <i>Mycenastrum corium</i>, <i>Mycenella salicina</i>, <i>Mycetinis alliaceus</i>, <i>Mycetinis scorodoni</i>, <i>Neolentinus adhaerens</i>, <i>Omphalotus olearius</i>, <i>Ossicaulis lignatilis</i>, <i>Panaeolus acuminatus</i>, <i>Panaeolus papilionaceus</i>, <i>Panaeolus teutonicus</i>, <i>Panellus stipticus</i>, <i>Panaeolus semiovatus</i>, <i>Panus conchatus</i>, <i>Paragymnopus perforans</i>, <i>Paralepista flaccida</i>, <i>Parasola plicatilis</i>, <i>Paxillus involutus</i>, <i>Phloeomania speirea</i>, <i>Pholiota adiposa</i>, <i>Pholiota squarrosa</i>, <i>Pholiota squarrosoides</i>, <i>Pholiotina arrhenii</i>, <i>Phyllotopsis nidulans</i>, <i>Pleurotus calyptratus</i>, <i>Pleurotus cornucopiae</i>, <i>Pleurotus dryinus</i>, <i>Pleurotus elongatipes</i>, <i>Pleurotus ostreatus</i>, <i>Pleurotus pulmonarius</i>, <i>Pluteus aurantiorugosus</i>, <i>Pluteus cervinus</i>, <i>Pluteus chrysophaeus</i>, <i>Pluteus depauperatus</i>, <i>Pluteus exiguus</i>, <i>Pluteus leoninus</i>, <i>Pluteus nanus</i>, <i>Pluteus salicinus</i>, <i>Pluteus semibulbosus</i>, <i>Pluteus thomsonii</i>, <i>Psathyrella candolleana</i>, <i>Psathyrella multipedata</i>, <i>Psathyrella obtusata</i>, <i>Psathyrella spadiceogrisea</i>, <i>Pseudoclitocybe cyathiformis</i>, <i>Pseudosperma rimosum</i>, <i>Resupinatus apiculatus</i>, <i>Rhodocollybia prolixa</i>, <i>Rubroboletus satanas</i>, <i>Russula acetolens</i>, <i>Russula anthracina</i>, <i>Russula atropurpurea</i>, <i>Russula brunneoviolacea</i>, <i>Russula emetica</i>, <i>Russula emeticolor</i>, <i>Russula farinipes</i>, <i>Russula foetens</i>, <i>Russula grisea</i>, <i>Russula integra</i>, <i>Russula olivacea</i>, <i>Russula pectinata</i>, <i>Russula puellaris</i>, <i>Russula queletii</i>, <i>Russula silvestris</i>, <i>Russula torulosa</i>, <i>Russula virescens</i>, <i>Sarcomyxa serotina</i>, <i>Sphagnurus paluster</i>, <i>Strobilurus esculentus</i>, <i>Strobilurus tenacellus</i>, <i>Suillus collinitus</i>, <i>Tricholoma acerbum</i>, <i>Tricholoma psammopus</i>, <i>Tricholoma cingulatum</i>, <i>Tricholoma ustale</i>, <i>Tricholoma ustaloides</i>, <i>Tricholoma vaccinum</i>, <i>Tubaria conspersa</i>, <i>Tylopilus felleus</i>, <i>Volvariella iranica</i>, <i>Volvariella hypophysis</i>, <i>Xerocomellus pruinatus</i>, <i>Xerocomus moravicus</i>. <i>Agaricus arvensis</i>, <i>Agaricus bisporus</i>, <i>Agaricus bitorquis</i>, <i>Agaricus iodosmus</i>, <i>Agaricus pseudopratinensis</i>, <i>Agrocybe dura</i>, <i>Agrocybe pediades</i>, <i>Agrocybe pusiola</i>, <i>Battarraea stevenii</i>, <i>Butyriboletus appendiculatus</i>, <i>Calocybe carnea</i>, <i>Calocybe gambosa</i>, <i>Conocybe albipes</i>, <i>Conocybe apala</i>, <i>Conocybe ochracea</i>, <i>Conocybe rickenii</i>, <i>Conocybe tenera</i>, <i>Coprinellus angulatus</i>, <i>Coprinellus disseminatus</i>, <i>Coprinellus flocculosus</i>, <i>Coprinellus micaceus</i>, <i>Coprinopsis atramentaria</i>, <i>Coprinopsis brunneofibrillosa</i>, <i>Coprinopsis cinerea</i>, <i>Coprinopsis lagopides</i>, <i>Coprinopsis macrocephala</i>, <i>Coprinopsis patouillardii</i>, <i>Coprinopsis scobicola</i>, <i>Coprinus comatus</i>, <i>Flammulaster granulosa</i>, <i>Flammulina velutipes</i>, <i>Gymnopus erythropus</i>, <i>Lentinus tigrinus</i>, <i>Leucoagaricus leucothites</i>, <i>Leucoagaricus roseoalbus</i>, <i>Marasmius atrorubens</i>, <i>Marasmius corrugatiformis</i>, <i>Marasmius favoloides</i>, <i>Marasmius ferrugineus</i>, <i>Marasmius haematocephalus</i>, <i>Marasmius rubroflavus</i>, <i>Melanoleuca graminicola</i>, <i>Melanoleuca grammopodia</i>, <i>Melanoleuca strictipes</i>, <i>Melanoleuca subpulverulenta</i>, <i>Mycenastrum corium</i>, <i>Myxomphalia maura</i>, <i>Ossicaulis salomii</i>, <i>Parasola plicatilis</i>, <i>Pholiota adiposa</i>, <i>Pholiota populnea</i>, <i>Pleurotus cornucopiae</i>, <i>Pleurotus eryngii</i>, <i>Pleurotus ostreatus</i>, <i>Psathyrella bivelata</i>, <i>Psathyrella candolleana</i>, <i>Psilocybe cyanescens</i>, <i>Psilocybe serbica</i>, <i>Suillus collinitus</i>, <i>Suillus granulatus</i>, <i>Tricholoma argyraceum</i>, <i>Tricholoma robustum</i>, <i>Tricholoma terreum</i>, <i>Tubaria furfuracea</i>, <i>Tubaria pallidosporea</i>.
Tehran	

Table 4. Continued.

Province	List of species
West Azerbaijan	<i>Agaricus arvensis</i> , <i>Agaricus bisporus</i> , <i>Agaricus bitorquis</i> , <i>Agaricus depauperatus</i> , <i>Agaricus gennadii</i> , <i>Agrocybe acericola</i> , <i>Agrocybe dura</i> , <i>Agrocybe praecox</i> , <i>Amanita phalloides</i> , <i>Armillaria mellea</i> , <i>Clitocybe diatreta</i> , <i>Coprinellus micaceus</i> , <i>Coprinopsis atramentaria</i> , <i>Lepiota helveola</i> , <i>Leucoagaricus americanus</i> , <i>Marasmius oreades</i> , <i>Pholiota adiposa</i> , <i>Pleurotus cornucopiae</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus ostreatus</i> , <i>Pluteus nanus</i> , <i>Psathyrella candolleana</i> , <i>Psathyrella spadiceogrisea</i> , <i>Saproamanita codinae</i> , <i>Stropharia melanosperma</i> , <i>Suillus collinitus</i> , <i>Tubaria furfuracea</i> , <i>Volvarellia volvacea</i> .
Yazd	–
Zanjan	<i>Agaricus arvensis</i> , <i>Lepista saeva</i> .
province not specified	<i>Butyriboletus pseudoregius</i> , <i>Chlorophyllum brunneum</i> , <i>Coprinellus domesticus</i> , <i>Coprinellus impatiens</i> , <i>Coprinellus silvaticus</i> , <i>Coprinellus xanthothrix</i> , <i>Coprinopsis friesii</i> , <i>Coprinopsis gonophylla</i> , <i>Coprinopsis marcescibilis</i> , <i>Coprinopsis sclerotiger</i> , <i>Cortinarius bivelus</i> , <i>Cortinarius caesiocortinatus</i> , <i>Cortinarius casimiri</i> , <i>Cortinarius cinnabarinus</i> , <i>Cortinarius cotoneus</i> , <i>Cortinarius diasemospermus</i> , <i>Cortinarius ferrugineovelatus</i> , <i>Cortinarius hinnuleus</i> , <i>Cortinarius infractus</i> , <i>Cortinarius olivaceofuscus</i> , <i>Cortinarius parvannulatus</i> , <i>Cortinarius uraceonemoralis</i> , <i>Cortinarius vernus</i> , <i>Craterellus tubaeformis</i> , <i>Entoloma subcollariatum</i> , <i>Flammula alnicola</i> , <i>Galerina hypnorum</i> , <i>Galerina mniophila</i> , <i>Galerina pumila</i> , <i>Galerina sphagnorum</i> , <i>Gymnopilus penetrans</i> , <i>Hebeloma birrus</i> , <i>Hebeloma crustuliniforme</i> , <i>Hebeloma incarnatum</i> , <i>Hebeloma mesophaeum</i> , <i>Hebeloma sinapizans</i> , <i>Homophron spadiceum</i> , <i>Imleria badia</i> , <i>Inocybe amethystina</i> , <i>Inocybe castaneicolor</i> , <i>Inocybe cincinnata</i> , <i>Inocybe decemgibbosa</i> , <i>Inocybe flocculosa</i> , <i>Inocybe godeyi</i> , <i>Inocybe hirtella</i> , <i>Inocybe huijsmanii</i> , <i>Inocybe langei</i> , <i>Inocybe mixtilis</i> , <i>Inocybe mystica</i> , <i>Inocybe pusio</i> , <i>Lactarius acris</i> , <i>Lactarius circellatus</i> , <i>Lactarius fulvissimus</i> , <i>Lactarius zonarius</i> , <i>Lepiota felina</i> , <i>Lepiota micropholis</i> , <i>Lepiota subalba</i> , <i>Leucocoprinus birnbaumii</i> , <i>Leucocoprinus brebissonii</i> , <i>Leucocoprinus cepistipes</i> , <i>Macrolepiota excoriata</i> , <i>Panaeolus speciosus</i> , <i>Parasola auricoma</i> , <i>Parasola hemerobia</i> , <i>Phaeomarasmius erinaceus</i> , <i>Phaeonematoloma myosotis</i> , <i>Pholiota astragalina</i> , <i>Pholiota scamba</i> , <i>Pholiota spumosa</i> , <i>Pholiotina aporos</i> , <i>Pluteus pellitus</i> , <i>Pluteus petasatus</i> , <i>Pluteus umbrosus</i> , <i>Psathyrella laevisima</i> , <i>Psathyrella microrhiza</i> , <i>Psathyrella pennata</i> , <i>Psathyrella piluliformis</i> , <i>Psathyrella prona</i> , <i>Psathyrella pseudogracilis</i> , <i>Psathyrella squamosa</i> , <i>Psilocybe coprophila</i> , <i>Russula luteotacta</i> , <i>Russula persicina</i> , <i>Russula rosea</i> , <i>Russula solaris</i> , <i>Russula versicolor</i> , <i>Russula veternosa</i> , <i>Russula vinosopurpurea</i> , <i>Volvarellia pusilla</i> .

Molecular study

In this study, a total number of 128 new nrDNA sequences was obtained, comprising 70 sequences from the ITS barcode region, and 58 sequences from the nrLSU (Table 3). The scrutiny through public databases GenBank and UNITE was also performed to extract the available DNA sequences of Iranian agarics and boletes and selected ITS accession numbers were inserted in Table 1 after careful checking. Our analyses show that in total, only 24% of Iranian agarics and bolete species have at least one publically available nrITS sequence, while 76% still lack any DNA sequences (Fig. 2d). We also show that 64 species of agarics and boletes in Iran are known from environmental sequences of ectomycorrhizal root tips (Fig. 2e). Moreover, nine species have been recovered as plant endophyte (Fig. 2e).

DISCUSSION

In this study, we presented a first annotated checklist of 585 species of agarics and boletes in Iran. To our current knowledge, perhaps except for *Agaricus iranicus* which is currently known only from Iran, there is no agaric nor bolete species endemic to the country. Also no lichenized agaric is yet known in Iran.

The ITS region has been a favored and practically suitable DNA barcode marker for identification of mushrooms (Dentinger et al. 2011). Here, we obtained 70 new ITS sequences, and have also made a full scrutiny of the sequences of Iranian agarics and boletes available in GenBank and UNITE. We tried to contrast environmental sequences against well-identified fungi

or the Species Hypothesis. Selected verified ITS sequences were reported in Table 1. Currently, only 24% of the Iranian agarics and boletes have at least one reliable ITS sequence in the public databases.

Application of sequence-based records in checklists and taxonomy studies is not straightforward. The majority of the extracted GenBank/UNITE sequences in our study are from environmental samples (Bahram et al. 2012 and 2013). Many include insufficiently identified sequences or lack vouchered basidiomata. Considering fruitbody-based sequences in GenBank, we also noticed that a perceptible number of them suffer from a wrong interpretation of Basic Local Alignment Search Tool (BLAST), with medium to large ignorance of standards of molecular identification. In most cases, we carefully did a re-BLAST, to correct for the identifications.

While sequences from environmental samples are highly important in ecological studies, using them in regional species checklists and taxonomy studies is still not routine. Interestingly, environmental samples (from ectomycorrhizal root tips) added 64 more species to our checklist.

Noteworthy, 42% of agaric and bolete species in Iran (248 out of 585 species) arise merely from congress abstracts, with no other supporting data in other sources. Usually, abstracts presented in congresses are intended as informal announcements of scientific research and are not regarded citable by most peer journals. The same also applies to university theses, dissertations, and research reports. Data including biodiversity records in such informal publications are more reliable when they are

subsequently supported by other types of evidence and published in peer reviewed journals or other formal publications. We noticed that many of these records lack sufficient characterization, species authority, or vouchers; so, they are considered here as tentative records. We preferred to keep these records in our checklist, to encourage more research on them, but recommend them to be used with caution. In the present work, we were able to confirm the presence of some of the previously recorded species by new specimens or by DNA sequences.

Recent studies highlight that climate change will be a serious threat for biodiversity in Iran due to severe habitat fragmentation and destruction, and land-use alteration, specifically in the North West, West (Zagros), and central parts of Iran (Yousefi et al. 2019). Although no studies have been done to test the impact of climate change on fungi in Iran, the range reductions predicted for some plant species (reviewed by Yousefi et al. 2019) might also affect their associated fungi, more notably ectomycorrhizae and wood-inhabiting macromycetes. It is highly probable that many species will go extinct before they are recorded. In Iran, agaric specialists are rare, while forest decline is intensive, which makes it even more imperative to record the agarics and boletes of the country. Undoubtedly, standard DNA barcodes would promote identification and verification of agarics and boletes in Iran; this would close the gap in the empirical knowledge of these fungi.

The above discussed problems of unverifiable literature records in congress abstracts, and the need to increase expertise in fungal molecular identification, are not limited to agarics and boletes but are also affecting other fungal groups in Iran. Tackling these problems would ultimately promote mycology and fungal conservation in Iran. Therefore, general recommendations are given to the mycological society in Iran, to prevent dissemination of low quality and ambiguous species records.

General recommendations:

- Biodiversity records in congress abstracts to be taken as provisional only, and not treated unequivocally. These records need to be backed up with proper citability and sufficient characterization.
- The specimens studied in dissertations, articles, etc. to be deposited in at least one of the Iranian herbaria registered in Index Herbariorum. Samples with unknown or inaccessible deposition should be ignored by the scientific society.
- For DNA studies, at least two primers should be used for amplification and sequencing of any given DNA region and the quality of obtained sequences' electropherograms carefully checked. Sequences resulting from a single primer, or with low quality trace files may cause serious misinterpretations in BLAST searches.
- In molecular identification, it is necessary to carefully follow standard routines. Exemplar procedures have been described by *e.g.* Nilsson et al. (2012), Køljalg et al. (2013), and Ryberg et al. (2008).
- Besides BLASTn, to make use of the UNITE platform to search for the best matching well-identified fungal taxon (Species Hypothesis).

Conclusions

This study provides a preliminary account on 585 species of agarics and boletes in Iran, with about half of them being regarded as tentative records. It fills in some of the gaps in our knowledge of these important groups of macrofungi in Iran and provides a framework for biodiversity and phylogenetic studies. Up to now, no taxonomic monograph/revision studies have been done for Iranian agarics and boletes, and among large species-rich genera in Iran (Fig. 2g), only the genus *Agaricus* has been taxonomically and phylogenetically studied (Mahdizadeh et al. 2017a, 2017b, 2016). Therefore, for the time being it is difficult to figure out the actual number of species of agarics and boletes in Iran.

The Hyrcanian region comprises only ca. 5% of the total area of Iran, yet a large proportion of the Iranian agarics and boletes (79%) come from this region. This pattern is similar for other macrobasidiomycetes of Iran such as aphyllorphoroid fungi (Ghobad-Nejhad & Hallenberg 2012). Macrofungi are vital members of forest ecosystems warranting their persistence and conservation. This accentuates the importance of taking immediate habitat protection strategies in the narrow, fragile Hyrcanian forests of Iran.

ACKNOWLEDGEMENTS

The authors thank Else C. Vellinga (Berkeley, USA) for providing comments and input in the use of names of taxa. Jacob Heilmann-Clausen (Copenhagen, Denmark) is thanked for some taxonomic notes and suggestions. Mohammad Sohrabi (Tehran, Iran) is gratefully acknowledged for field surveys accompany. This work has been supported by the Center for International Scientific Studies & Collaboration (CISSC), Ministry of Science, Research and Technology.

REFERENCES

I. Main list

- Akhani H, Djamali M, Ghorbanalizadeh A, Ramezani E. 2010. Plant biodiversity of Hyrcanian relict forests, N Iran: an overview of the flora, vegetation, palaeoecology and conservation. *Pakistan Journal of Botany* 42: 231–258.
- Altschul SF, Gish W, Miller W, Myers EW, Lipman DJ. 1990. Basic local alignment search tool. *Journal of Molecular Biology* 215: 403–410.

- Antonín V, Noordeloos ME. 2010. A monograph of marasmiod and collybioid fungi in Europe. IHW Verlag, Eching. 478 pp.
- Antonín V, Sedláč P, Tomšovský M. 2013. Taxonomy and phylogeny of European *Gymnopus* subsection *Levipedes* (Basidiomycota, Omphalotaceae). *Persoonia* 31: 179–187.
- Aronsen A, Læssøe T. 2016. The genus *Mycena* s.l. Fungi of Northern Europe 5. 373 pp. Danish Mycological Society, Copenhagen.
- Asef MR. 2015. New records of the genus *Lepiota* for Iran, including two deadly poisonous species. *Mycologica Iranica* 2: 89–94.
- Asef MR. 2014. Addition to the knowledge of the genus *Agaricus* in Iran. *Rostaniha* 15: 79–84.
- Asef MR. 2013. First report of *Strobilomyces* strobilaceous from Iran. *Rostaniha* 14: 249.
- Asef MR. 2011a. Macrofungi of Arasbaran (4. Family Russulaceae). *Rostaniha* 12: 31–38.
- Asef MR. 2011b. First report of subterranean development of an agaric fungus in Iran. *Rostaniha* 12: 91–92.
- Asef MR. 2009a. Macrofungi of Arasbaran (NW Iran) 3. *Cortinarius* subgenus *Phlegmacium*. *Rostaniha* 10: 80–90.
- Asef MR. 2009b. Five new records of the genus *Clitocybe* from Iranian part of Caucasia. *Rostaniha* 10: 203–211.
- Asef MR. 2008. Macrofungi of Arasbaran (NW Iran). 2. Bolete fungi (families Boletaceae and Suillaceae). *Rostaniha* 9: 210–229 & 91–92 (English).
- Asef MR. 2007a. Macrofungi of Arasbaran (NW Iran). 1. *Cortinarius* subgenus *Myxarium*. *Rostaniha* 8: 178–185 (Farsi), 84–86 (English).
- Asef MR, Etemad V. 2016. Identification of agaric fungi of Kheyroud Research Forest, Noshahr. *Rostaniha* 17: 19–27.
- Asef MG, Khosravi V, Naeimi S. 2015. First report of *Coprinopsis* *urticicola* from Iran. *Mycologia Iranica* 2: 141.
- Asef MR, Mohammadi Goltapeh E. 2002. New hosts for *Armillaria* species in Iran. *Iranian Journal of Plant Pathology* 38: 278–279.
- Asef MR, Mohammadi Goltapeh E, Alizadeh A. 2003. Identification of *Armillaria* biological species in Iran. *Fungal Diversity* 14: 51–60.
- Asef MR, Muradov P. 2014. New records of agaric fungi from East Azarbaijan (Iran). *Rostaniha* 15: 43–49.
- Bahram M, Asef MR, Zarre S, Abbasi M, Reidl S. 2006a. Addition to the knowledge of *Amanita* (Agaricales, Pluteaceae) from Iran. *Rostaniha* 7: 107–118.
- Bahram M, Kõljalg U, Kohout P, Mirshahvaladi S, Tedersoo L. 2013. Ectomycorrhizal fungi of exotic pine plantations in relation to native host trees in Iran: evidence of host range expansion by local symbionts to distantly related host taxa. *Mycorrhiza* 23: 11–19.
- Bahram M, Pölme S, Kõljalg U, Zarre S, Tedersoo L. 2012. Regional and local patterns of ectomycorrhizal fungal diversity and community structure along an altitudinal gradient in the Hyrcanian forests of northern Iran. *New Phytologist* 193: 465–473.
- Bari E, Aghajani H, Ohno KM, Shahi R, Hale MD, Bahmani M. 2019. Ecology of wood-inhabiting fungi in northern forests of Iran. *Forest Pathology* 49: e12501.
- Buhse F. 1860. Aufzählung der auf einer Reise durch Transkaukasien und Persien gesammelten Pflanzen in Gemeinschaft mit Dr. E. Boissier in Genf (travel report with several indices, one map and plant illustrations). *Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscou* 12: i–lxvii + 1–246.
- Buškamp J, Langer GJ, Langer EJ. 2020. *Sphaeropsis* *sapinea* and fungal endophyte diversity in twigs of Scots pine (*Pinus sylvestris*) in Germany. *Mycological Progress* 19: 985–999.
- Chang ST, Miles PG. 2004. Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact. 2nd ed. CRC Press Boca Raton London. 477 pp.
- Coetzee MP, Wingfield BD, Bloomer P, Wingfield MJ. 2005. Phylogenetic analyses of DNA sequences reveal species partitions amongst isolates of *Armillaria* from Africa. *Mycological Research* 109: 1223–1234.
- Dalili SAR, Nanagulyan SG, Alavi SV. 2008. Identification of *Armillaria* species on different hosts from Iran. *Mycologia Balcanica* 5: 119–122.
- Dentinger BTM, Didukh MY, Moncalvo JM. 2011. Comparing COI and ITS as DNA barcode markers for mushrooms and allies (Agaricomycotina). *PLoS ONE* 6: e25081.
- Djamali M, Brewer S, Breckle SW, Jackson ST. 2012. Climatic determinism in phytogeographic regionalization: a test from the Irano-Turanian region, SW and Central Asia. *Flora* 207: 237–49.
- Djamali M, Akhiani H, Khoshroavesh R, Andrieu-Ponel V, Ponel P, Brewer S. 2011. Application of the global bioclimatic classification to Iran: implications for understanding the modern vegetation and biogeography. *Ecologia Mediterranea* 37: 91–114.
- Ershad D, Zare R. 2014. Brief history of mycology in Iran. *Mycologia Iranica* 1: 53–63.
- Ershad D. 2009. Fungi of Iran. Plant Pests and Diseases Research Institute, Department of Botany, Tehran. 531 pp.
- Ershad D. 1995. Fungi of Iran. Ministry of Agriculture. Agricultural Research, Education and Extension Organization. No. 10. 874 pp.
- Esfandiari E. 1951. Quatrième liste de fungi de l'Iran. *Entomologie Phytopathologie appliquées* 12–13: 1–26.
- Esfandiari E. 1948. Troisième liste des fungi ramassés en Iran. *Entomologie Phytopathologie appliquées* 8: 1–15.

- Esfandiari E. 1946. Contribution à l'étude de la mycoflore de l'Iran. Depart. Gen. Protect. Plant, Teheran (in Farsi).
- Fadavi S, Abbasi S, Asef MR. 2015. A contribution to the identification of agaric fungi of Kermanshah, W Iran (2). Families Agaricaceae, Inocybaceae, Pluteaceae and Polyporaceae. *Rostaniha* 16: 1–16.
- Fadavi S, Asef MR, Abbasi S. 2013. A contribution to the identification of agaric fungi of Kermanshah province, W Iran. *Rostaniha* 14: 95–107.
- Fallahyan F. 1973. Contribution à la flore mycologique de l'Iran. *Macromycètes. Revue de Mycologie* 38: 243–244.
- Frey W, Kürschner H, Probst W. 1999. Flora and vegetation, including plant species and larger vegetation complexes in Persia. In: Yarshater E (ed.). *Encyclopaedia Iranica*. 10th ed. Mazda Publishers, Costa Mesa. Pp. 43–63.
- Gardes M, Bruns TD. 1993. ITS primers with enhanced specificity for basidiomycetes - application to the identification of mycorrhizae and rusts. *Molecular Ecology* 2: 113–118.
- Gholizadeh H, Naqinezhad A, Chytrý M. 2020. Classification of the Hyrcanian forest vegetation, Northern Iran. *Applied Vegetation Science* 23: 107–26.
- Ghobad-Nejhad M. 2011. Wood-inhabiting basidiomycetes in the Caucasus region - systematics and biogeography. *Publications in Botany from the University of Helsinki*. No 40. Yliopistopaino.
- Ghobad-Nejhad M, Bernicchia A. 2019. An outlook on the diversity of polypores shared between Iran and the Mediterranean area. *Mycologia Iranica* 6: 33–39.
- Ghobad-Nejhad M, Hallenberg N. 2012. Checklist of Iranian non-gilled/non-gasteroid hymenomycetes (Agaricomycotina). *Mycotaxon* 119: 494 (41 pp).
- Ghobad-Nejhad M, Asgari B, Chaharmiri Dokhaharani S. 2017. Notes on some endophytic fungi isolated from *Quercus brantii* in Dena region of Kohgiluyeh and Boyer-Ahmad province, Iran. *Mycologia Iranica* 4: 1–12.
- Ghobad-Nejhad M, Langer E. 2017. First inventory of aphyllorphoroid basidiomycetes of Zagros forests, W Iran. *Plant Biosystems* 151: 844–854.
- Gholami M, Amini J, Abdollahzadeh J, Ashengroph M. 2019. Basidiomycete fungi as biocontrol agents against take-all disease of wheat. *Biological Control* 130: 34–43.
- Grand EA, Hughes KW, Petersen RH. 2011. Relationships within *Lentinus* subg. *Lentinus* (Polyporales, Agaricomycetes), with emphasis on sects. *Lentinus* and *Tigrini*. *Mycological progress* 10(4): 399–413.
- Halbwachs H, Simmel J, Bässler C. 2016. Tales and mysteries of fungal fruiting: how morphological and physiological traits affect a pileate lifestyle. *Fungal Biology Reviews* 30: 36–61.
- He MQ, Zhao RL, Hyde KD, Begerow D, Kemler M, Yurkov M, McKenzie EHC, et al. 2019. Notes, outline and divergence times of Basidiomycota. *Fungal Diversity* 99: 105–367.
- Heim R. 1960. Le pleurote des ombellifères en Iran. *Revue de Mycologie* 25: 242–247.
- Hibbett DS, Pine EM, Langer E, Langer G, Donoghue MJ. 1997. Evolution of gilled mushrooms and puffballs inferred from ribosomal DNA sequences. *Proceedings of the national academy of sciences* 94: 12002–12006.
- Irani H, Kiumarsi SH, Ommati F, Ershad D. 2003. Etiological study of stone fruit dieback and decline in West Azerbaijan, Semnan, and Kerman provinces. *Iranian Journal of Plant Pathology* 39: 57–72 (Farsi), 15–18 (English).
- Jadidian A, Zafari D, Asef MR. 2015. New records of agaric fungi from Hamedan province, Iran (families Bolbitiaceae, Inocybaceae, Psathyrellaceae and Tricholomataceae). *Rostaniha* 16: 101–108.
- Justo A, Minnis AM, Ghignone S, Menolli N, Capelari M, Rodríguez O, Malysheva E, Contu M, Vizzini A. 2011. Species recognition in *Pluteus* and *Volvopluteus* (Pluteaceae, Agaricales): morphology, geography and phylogeny. *Mycological Progress* 10: 453–479.
- Khabiri E. 1968. Plant diseases: parasitic fungi, 5. Tehran University Press, Tehran. (In Farsi)
- Keča N, Klopfenstein NB, Kim MS, Solheim H, Woodward S. 2015. Initial characterization of an unidentified *Armillaria* isolate from Serbia using LSU-IGS 1 and TEF-1- α genes. *Forest Pathology* 45:120–126.
- Kibby G, Burnham A, Henrici A. 2009. *Cortinarius* subgenus *Myxaciium*. *Field mycology*10: 41–55.
- Kirk PM, Cannon PF, David JC, Stalpers JA. 2001. *Dictionary of the Fungi*. 10th ed. CAB International, Wallingford, UK.
- Köljalg U, Nilsson RH, Abarenkov K, Tedersoo L, Taylor AF, Bahram M, Bates ST, Bruns TD, Bengtsson-Palme J, Callaghan TM, Douglas B. 2013. Towards a unified paradigm for sequence-based identification of fungi. *Molecular Ecology* 22: 5271–5277.
- Knudsen H, Vesterholt J (eds). 2008. *Funga Nordica*. Agaricoid, boletoid and cyphelloid genera. Nordsvamp, Copenhagen, Denmark. 965 pp.
- Largent DL, Johnson D, Watling R. 1977. How to identify mushrooms to genus. III. Microscopic features. Mad River. Eureka, California.
- Mahdizadeh V, Parra LA, Safaie N, Mohammadi Goltapeh E, Chen J, Guinbertau J, Callac P. 2017a. A phylogenetic and morphological overview of sections *Bohusia*, *Sanguinolenti*, and allied sections within *Agaricus* subg. *Pseudochiton* with three new species from France, Iran, and Portugal. *Fungal Biology* 122: 34–51.
- Mahdizadeh V, Safaie N, Mohammadi Goltapeh E, Asef MR, Callac P. 2017b. Medicinal mushroom *Agaricus subrufescens* from Iran shares genetic markers with specimens from China and Thailand. *Botany* 95: 579–585.

- Mahdizadeh V, Safaie N, Mohammadi Goltapeh E, Asef MR, Nassaj Hosseini SM, Callac P. 2016. *Agaricus* section *Xanthodermatei* in Iran. *Phytotaxa* 247: 181–196.
- Manafzadeh S, Staedler YM, Conti E. 2017. Visions of the past and dreams of the future in the Orient: the Irano-Turanian region from classical botany to evolutionary studies. *Biological reviews* 92: 1365–1388.
- Matheny PB, Curtis JM, Hofstetter V, Aime C, Moncalvo JM, Ge ZW, et al. 2006. Major clades of Agaricales: a multilocus phylogenetic overview. *Mycologia* 98: 982–995.
- Meinhardt LW, Rincones J, Bailey BA, Aime MC, Griffith GW, Zhang D, Pereira GA. 2008. *Moniliophthora perniciosa*, the causal agent of witches' broom disease of cacao: what's new from this old foe? *Molecular plant pathology* 9: 577–588.
- Mittermeier RA, Robles GP, Hoffman M, Pilgrim J, Brooks T, Mittermeier CG, et al. 2005. Hotspots revisited: earth's biologically richest and most endangered terrestrial ecoregions. Washington D.C., USA: Conservation International.
- Mohammadi Goltapeh E. 2003. Identification of eleven species of *Coprinus* from Iran. *Rostaniha* 4: 39–56 (Farsi), 55–59 (English).
- Mohammadi Goltapeh E. 2002. Identification of five species of *Lepiota* from Iran. *Rostaniha* 2: 15–29 (Farsi), 11–19 (English).
- Mohammadi Goltapeh E. 2001. Some interesting agarics from Iran. *Rostaniha* 2: 15–29 (Farsi), 11–19 (English).
- Mohammadi Goltapeh E. 2000a. *Asterophora lycoperdoides*, a parasitic agaric new to Iran. *Modares Agricultural Science* 1: 114–116.
- Mohammadi Goltapeh E, Asef MR, Pourjam E, Rezai Danesh Y. 2004. Six new records of *Agaricus* from Iran. *Rostaniha* 5(1): 77–87 (Farsi), 25–31 (English).
- Moncalvo JM, Vilgalys R, Redhead SA, Johnson JE, James TY, et al. 2002. One hundred and seventeen clades of euagarics. *Molecular Phylogenetics and Evolution* 23: 357–400.
- Mozaffarian V. 2005. *Trees and Shrubs of Iran*. Farhang Moaser Publishers. Tehran (Iran). 1003 pp. In Persian.
- Nilsson RH, Larsson KH, Taylor AF, Bengtsson-Palme J, Jeppesen TS, Schigel D, Kennedy P, Picard K, Glöckner FO, Tedersoo L, Saar I. 2019. The UNITE database for molecular identification of fungi: handling dark taxa and parallel taxonomic classifications. *Nucleic Acids Research* 47(D1): D259–D264.
- Nilsson RH, Tedersoo L, Abarenkov K, et al. 2012. Five simple guidelines for establishing basic authenticity and reliability of newly generated fungal ITS sequences. *MycKeys* 4: 37–63.
- Noroozi J. 2020. Plant biogeography and vegetation of high mountains of Central and South-West Asia. Switzerland: Springer.
- Noroozi J, Talebi A, Doostmohammadi M, Manafzadeh S, Asgarpour Z, Schneeweiss GM. 2019. Endemic diversity and distribution of the Iranian vascular flora across phytogeographical regions, biodiversity hotspots and areas of endemism. *Scientific reports* 9: 12991.
- Parad GA, Ghobad-Nejhad M, Tabari M, Yousefzadeh H, Esmailzadeh O, Tedersoo L, Buyck B. 2018. *Cantharellus alborufescens* and *C. ferruginascens* (Cantharellaceae, Basidiomycota) new to Iran. *Cryptogamie, Mycologie* 39: 1–12.
- Petrak F. 1949. Beiträge zur Pilzflora Irans. *Sydowia* 3: 268–332.
- Petrak F. 1941. Beiträge zur Kenntnis der Orientalischen Pilzflora. *Ann. Naturh. Mus. Wien* 52: 301–396.
- Petrak F. 1940. Fungi. In: Rechinger KH, Baumgartner J, Petrak F, Szatala O. *Ergebnisse einer botanischen Reise nach dem Iran*. *Annalen des Naturhistorischen Hofmuseums* 50: 414–521.
- Petrak F, Esfandiari E. 1941. Beiträge zur Kenntnis der iranischen Pilzflora. *Annales Mycologici* 39: 204–228.
- Rabenhorst L. 1871. Übersicht der von Herrn Prof. Dr. Haussknecht im Orient gesammelten Kryptogamen. *Hedwigia* 10: 17–27.
- Ravanbakhsh H, Hamzee B, Etemad V, Marvie Mohadjer MR, Assadi M. 2016. Phytosociology of *Juniperus excelsa* M. Bieb. forests in Alborz mountain range in the north of Iran. *Plant Biosystems* 150: 987–1000.
- Ravash R, Shiran B, Alavi AA, Bayat F, Rajaei S, Zervakis GI. 2010. Genetic variability and molecular phylogeny of *Pleurotus eryngii* species-complex isolates from Iran, and notes on the systematics of Asiatic populations. *Mycological Progress* 9: 181–194.
- Ryberg M, Nilsson RH, Kristiansson E, Töpel M, Jacobsson S, Larsson E. 2008. Mining metadata from unidentified ITS sequences in GenBank: a case study in *Inocybe* (Basidiomycota). *BMC Evolutionary Biology* 8: 50.
- Saber M. 1999. The species of *Inocybe* in Iran. *Iranian Journal of Plant Pathology* 35: 19–36.
- Saber M. 1997a. New records of Agaricales (pleurotoid in habit) from Iran. *Iranian Journal of Plant Pathology* 33: 155–183.
- Saber M. 1997c. *Lactarius glaucescens*, a new record for Iran. *Iranian Journal of Plant Pathology* 33: 218.
- Saber M. 1995a. The species of *Amanita* in Iran. *Iranian Journal of Plant Pathology* 31: 38–47.
- Saber M. 1995b. New records of Aphyllophorales and gasteromycetes for Iran. *Iranian Journal of Plant Pathology* 31: 48–57.
- Saber M. 1990. Contribution to the knowledge of Agaricales pleurotoid in habit in Iran. *Iranian Journal of Plant Pathology* 26: 73–116.
- Saber M. 1989a. The species of *Lactarius* in Iran. *Iranian Journal of Plant Protection* 25: 39–47.

- Saber M. 1989b. New records of Aphyllophorales and gasteromycetes for Iran. *Iranian Journal of Plant Pathology* 25: 59–72.
- Saber M. 1987. Contribution to the knowledge of Aphyllophorales collected in Iran. *Iranian Journal of Plant Pathology* 23: 63–101.
- Saber M. 1986. Contribution to the knowledge of gasteromycetes collected in Iran. *Iranian Journal of Plant Pathology* 22: 69–100.
- Saber M. 1973. *Armillaria* root rot. *Iranian Journal of Plant Pathology* 9: 45–62.
- Saber M, Abaei M. 2001. *Pleurotus calyptratus*, a new record for Iran. *Rostaniha* 2: 101–103.
- Saber M, Mehravaran H. 2001. *Amanita codinae*, a new record for Iran. *Rostaniha* 2: 103–104.
- Saber M, Zangeneh S. 2000. *Amanita strobiliformis*, a new record for Iran. *Rostaniha* 1: 167–168.
- Sagheb Talebi K, Sajedi T, Pourhashemi M. 2014. Forests of Iran: a treasure from the past, a hope for the future. In: Werger MJA (ed). *Plant and vegetation* 10. Dordrecht: Springer. 157 pp.
- Sanger F, Nicklen S, Coulson AR. 1977. DNA sequencing with chain-terminating inhibitors. *Proceedings of the National Academy of Sciences of the United States of America* 74: 5463–5467.
- Seidmohammadi E, Abbasi S, Asef MR. 2019. The first report of *Panaeolus olivaceus* and *Panaeolus guttulatus* from Iran. *Taxonomy and Biosystematics* 11: 23–30.
- Seidmohammadi E, Abbasi S, Asef MR. 2018a. First report of *Pluteus cinereofuscus* for mycobiota of Iran. *Rostaniha* 19: 192–195.
- Seidmohammadi E, Abbasi S, Asef MR. 2018b. The first report of *Agaricus devoniensis* and *Agaricus nevoi* from Kermanshah Province. *Proceedings of first congress on biotechnology of medicinal plants and mountain fungi, Zanjan* (full paper): 372–378.
- Seidmohammadi E, Abbasi S, Asef MR. 2017. *Suillellus comptus*, new report for the Mycobiota of Iran. *Mycologia Iranica* 4: 63–64.
- Shahtahmasebi SH, Pourianfar HR, Mahdizadeh V, Shahzadeh Fazeli SA, Amoozegar MA, Nasr SH, Zabihi SS, Rezaeian SH, Malekzadeh KH, Janpoor J. 2018. A preliminary study on domestication of wild-growing medicinal mushrooms collected from Northern Iran. *Current Research in Environmental and Applied Mycology* 8: 606–623.
- Shearer BL, Tippet JT. 1988. Distribution and impact of *Armillaria luteobubalina* in the *Eucalyptus marginata* forest of south-western Australia. *Australian Journal of Botany* 36: 433–445.
- Soleimani P. 1976. Wood destroying fungi in Iran. *European Journal of Forest Pathology* 6: 75–79.
- Soleimani P. 1974. An overview of wood-destroying fungi of Iran. *Bulletin of the Faculty of Natural Resources, University of Teheran*. No. 29. Pp. 15–40. (In Farsi).
- Tamura K, Stecher G, Peterson D, Filipowski A, Kumar S. 2013. MEGA6: molecular evolutionary genetics analysis version 6.0. *Molecular Biology and Evolution* 30: 2725–2729.
- Teimoori-Boghsani Y, Ganjeali A, Cernava T, Müller H, Asili J, Berg G. 2020. Endophytic fungi of native *Salvia abrotanoides* plants reveal high taxonomic diversity and unique profiles of secondary metabolites. *Frontiers in Microbiology* 10: 3013.
- Vahidi H, Mojab F, Taghavi N. 2006. Effects of carbon sources on growth and production of antifungal agents by *Gymnopilus spectabilis*. *Iranian Journal of pharmaceutical research* 20: 219–222.
- Varga T, Krizsán K, Földi C, Dima B, Sánchez-García M, Sánchez-Ramírez S, et al. 2019. Megaphylogeny resolves global patterns of mushroom evolution. *Nature Ecology and Evolution* 3: 668–678.
- Vilgalys R, Hester M. 1990. Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several *Cryptococcus* species. *Journal of Bacteriology* 172: 4238–4246.
- Voto P, Dovana F, Garbelotto M. 2019. A revision of the genus *Psathyrella*, with a focus on subsection *Spadiceogriseae*. *Fungal Systematics and Evolution* 4: 97–170.
- Watling R, Gregory J. 1977. Larger fungi from Turkey, Iran, and neighboring countries. *Karstenia* 17: 59–72.
- Watling R, Sweeney J. 1974. Larger fungi from Iran. Notes from the Royal Botanic Garden Edinburgh 33: 333–339.
- White TJ, Bruns T, Lee S, Taylor J. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In: Innis MA, Gelfand DH, Sninsky JJ, White TJ (eds). *PCR protocols: a guide to methods and applications*. Academic Press, New York. Pp. 315–322.
- Wu G, Feng B, Xu JP, Zhu XT, Li YC, Zeng NK, et al. 2014. Molecular phylogenetic analyses redefine seven major clades and reveal 22 new generic clades in the fungal family Boletaceae. *Fungal Diversity* 69: 93–115.
- Yousefi M, Kafash A, Valizadegan N, Ilanloo SS, Rajabizadeh M, Malekoutikhah S, Yousefkhani SS, Ashrafi S. 2019. Climate change is a major problem for biodiversity Conservation: a systematic review of recent studies in Iran. *Contemporary Problems of Ecology*. 394–403.
- Yousefshahi B, Bazgir M, Jamali S, Kakhki FV. 2020. Morphological and molecular identification of ectomycorrhizal fungi associated with Persian oak (*Quercus brantii* Lindl.) tree. *Journal of Forest Science* 66: 244–251.
- Zervakis GI, Ntougias S, Gargano ML, Besi MI, Polemis E, Typas MA, Venturella G. 2014. A reappraisal of the *Pleurotus eryngii* complex – New species and taxonomic combinations based on the application of a polyphasic approach, and an identification key to *Pleurotus* taxa associated with Apiaceae plants. *Fungal Biology* 118: 814–834.
- Zhao RL, Li GJ, Sánchez-Ramírez S, Stata M, Yang ZL, et al. 2017. A six-gene phylogenetic overview of Basidiomycota and allied phyla with estimated

divergence times of higher taxa and a phyloproteomics perspective. *Fungal Diversity* 84: 43–74.

Ziaie Juybari HZ, Tajick Ghanbary MA, Rahimian H, Karimi K, Arzanlou M. 2019. Seasonal, tissue and age influences on frequency and biodiversity of endophytic fungi of *Citrus sinensis* in Iran. *Forest Pathology* 49: e12559.

Zohary M. 1973. *Geobotanical foundations of the Middle East*. Vols. 1–2. Fischer, Stuttgart.

Zokaei M. 2001. Identification of Agaricales collected in Mashhad area. *Rostaniha* 2: 7–14.

II. Congress abstracts and dissertation (informal references)

Amirahmadi A, Khabbaz Jolfaei H, Asef MR. 2006. First report of *Armillaria mellea* on pistachio, apricot, pomegranate and fig from Iran. *Proceedings of the 17th Iranian Plant Protection Congress*. Vol. II, 2–5 Sept., Karaj, Iran: 410.

Asef MR. 2007b. Agaric flora of northwest forests of Iran. *XV Congress of European Mycologists*, 16–21 Sept., Saint Petersburg, Russia.

Asef MR, Tavanai GH. 2004. Preliminary identification of macromycetes of Arasbaran (East Azerbaijan). *Proceedings of 16th Iranian Plant Protection Congress*, Tabriz. Abstract book, p. 473.

Bahram M, Asef MR. 2008a. New species of Agaricales for mycoflora of Iran. *Proceedings of the 18th Iranian Plant Protection Congress*, 24–27 Aug., Hamedan, Iran: 650.

Bahram M, Asef MR. 2008b. Three new species of *Russula* for Iran. *Proceedings of the 18th Iranian Plant Protection Congress*, 24–27 Aug., Hamedan, Iran: 670.

Bahram M, Asef MR, Zarre S, Abbasi M. 2006a. Two new basidiomycetes for Iran. *Proceedings of the 17th Iranian Plant Protection Congress*. Vol. II, 2–5 Sept., Karaj, Iran: 438.

Behboudi B, Sabahi A. 1983. Study of honey mushroom in Isfahan, identification of damaged regions and factors affecting the intensity of pathogenicity. *Proceedings of 7th Iranian Plant Protection Congress*. 3–7 Sept., Karaj, Iran: 106–107.

Mahdizadeh V. 2016. Taxonomy of the genus *Agaricus* in Iran. PhD dissertation. Faculty of Agriculture, Tabiat Modares University.

Mohammadi Goltapeh E. 2004. Six new records of *Marasmius* from Iran. *Proceedings of 16th Iranian Plant Protection Congress*. Vol. II, 28 Aug. –1 Sept. Tabriz, Iran: 497.

Mohammadi Goltapeh E. 2000b. A contribution to the identification of *Coprinus* species of Iran. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 372.

Mohammadipour M. 2000. Study on *Armillariella mellea* causal agent of almond root in East Azerbaijan. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 330.

Razavi I, Rahnama K, Amozadeh-Omrani R. 2000. Isolation of fungi also associated with root rot in sweet cherry trees in Larijan region of Amol. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 321.

Razzaz-Hashemi SR, Zakeri Z. 2000. Identification of fungi on hazelnut in Alamour region in Qazvin. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 334.

Saber M. 2002a. Contribution to the knowledge of clitocyboid and omphalinoid fungi collected in Iran. *Proceedings of the 15th Iranian Plant Protection Congress*. Vol. II, 7–11 Sept., Kermanshah, Iran: 173.

Saber M. 2002b. Introduction of some new species of clavarioid and gasteromycetes for Iran. *Proceedings of the 15th Iranian Plant Protection Congress*. Vol. II, 7–11 Sept., Kermanshah, Iran: 285.

Saber M. 2000a. The species of *Russula* in Iran. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 373.

Saber M. 2000b. Four new records of gasteromycetes from Iran. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 376.

Saber M. 2000c. New records of Agaricales from Iran. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 381.

Saber M. 2000d. Contribution to the knowledge of tricholomatoid fungi collected in Iran. *Proceedings of the 14th Iranian Plant Protection Congress*. Vol. II, 5–8 Sept., Esfahan, Iran: 382.

Saber M. 1998. Contribution to the knowledge of collybioid fungi (*Tricholomataceae*) collected in Iran. *Proceedings of the 13th Iranian Plant Protection Congress*. Vol. II, 23–27 Aug., Karaj, Iran: 287.

Saber M. 1995d. Contribution to the knowledge of *Boletaceae* (*Agaricales*) collected in Iran. *Proceedings of 12th Iranian Plant Protection Congress*, 2–7 Sept., Karaj, Iran: 374.

Saber M. 1995e. Eight new records of pleurotoid agarics (*Agaricales*) from Iran. *Proceedings of 12th Iranian Plant Protection Congress*, 2–7 Sept., Karaj, Iran: 375.

Saber M. 1995f. New records of Agaricales from Iran. *Proceedings of 12th Iranian Plant Protection Congress*, 2–7 Sept., Karaj, Iran: 376.

Saber M. 1995g. Contribution to the knowledge of marasmiod fungi (*Tricholomataceae*) collected in Iran. *Proceedings of 12th Iranian Plant Protection Congress*, 2–7 Sept., Karaj, Iran: 377.

Saber M. 1995h. Contribution to the knowledge of mycenoid fungi (*Tricholomataceae*) collected in Iran. *Proceedings of 12th Iranian Plant Protection Congress*, 2–7 Sept., Karaj, Iran: 378.

Saber M. 1994a. Contribution to the knowledge of *Agaricaceae* (*Agaricales*) collected in Iran. *Fifth International Mycological Congress*, 14–21 Aug., Vancouver, Canada.

- Saber M. 1994b. Contribution to the knowledge of Coprinaceae (Agaricales) collected in Iran. Fifth International Mycological Congress, 14–21 Aug., Vancouver, Canada.
- Saber M. 1994c. Contribution to the knowledge of Cortinariaceae (Agaricales) collected in Iran. Fifth International Mycological Congress, 14–21 Aug., Vancouver, Canada.
- Saber M. 1993a. New records of Strophariaceae (Agaricales) from Iran. Proceedings of the 11th Iranian Plant Protection Congress, 28 Aug. – 2 Sept., Rasht, Iran: 284.
- Saber M. 1993b. New records of gasteromycetes from Iran. Proceedings of the 11th Iranian Plant Protection Congress, 28 Aug. – 2 Sept., Rasht, Iran: 285.
- Saber M. 1993c. Two new records of pleurotoid in habit (Agaricales) from Iran. Proceedings of the 11th Iranian Plant Protection Congress, 28 Aug. – 2 Sept., Rasht, Iran: 287.
- Saber M. 1993d. New records of Hygrophoraceae, Entolomataceae, and Paxillaceae (Agaricales) collected in Iran. Proceedings of the 11th Iranian Plant Protection Congress, 28 Aug. – 2 Sept., Rasht, Iran: 288.
- Saber M. 1993e. New records of Pluteaceae (Agaricales) from Iran. Proceedings of the 11th Iranian Plant Protection Congress, 28 Aug. – 2 Sept., Rasht, Iran: 288.
- Saber M. 1993f. Contribution to the knowledge of Bolbitiaceae (Agaricales) collected in Iran. Proceedings of the 11th Iranian Plant Protection Congress, 28 Aug. – 2 Sept., Rasht, Iran: 290.
- Saber M. 1991a. Contribution to the knowledge of Amanitaceae and Pluteaceae (Agaricales) collected in Iran. Proceedings of 10th Iranian Plant Protection Congress, 1–5 Sept., Kerman, Iran: 135.
- Saber M. 1991b. Contribution to the knowledge of Strophariaceae (Agaricales) collected in Iran. Proceedings of 10th Iranian Plant Protection Congress, 1–5 Sept., Kerman, Iran: 137.
- Saber M, Dadkhahipour K. 2000. A report on basidiomycete fungi from Iranian Isles of Persian Gulf. Proceedings of the 14th Iranian Plant Protection Congress. Vol. II, 5–8 Sept., Esfahan, Iran: 375.
- Saber M, Esmaeili Taheri A. 2004. A report on macromycete fungi from different parts of Iran. Proceedings of 16th Iranian Plant Protection Congress. Vol. II, 28 Aug. –1 Sept. Tabriz, Iran: 464.
- Saber M, Esmaeili Taheri A. 2002. A report on basidiomycete fungi from Kashan. Proceedings of the 15th Iranian Plant Protection Congress. Vol. II, 7–11 Sept., Kermanshah, Iran: 171–172.
- Saber M, Ershad D. 2004. New records of Russula from Iran. Proceedings of 16th Iranian Plant Protection Congress. Vol. II, 28 Aug. –1 Sept. Tabriz, Iran: 462.
- Saber M, Mehravaran H. 2004. Records of macromycetes from Urmia, West Azerbaijan Province. Proceedings of 16th Iranian Plant Protection Congress. Vol. II, 28 Aug. –1 Sept. Tabriz, Iran: 465.
- Saber M, Zangeneh S. 2004. New records of macromycetes from Iran. Proceedings of 16th Iranian Plant Protection Congress. Vol. II, 28 Aug. –1 Sept. Tabriz, Iran: 463.
- Saber M, Zangeneh S. 2002. New records of Agaricales from Iran. Proceedings of the 15th Iranian Plant Protection Congress. Vol. II, 7–11 Sept., Kermanshah, Iran: 172–173.
- Svrček M. 1961. *Conocybe aberrans* Kühner a *Psathyrella panaeoloides* R. Maire, dva nové druhy lupenatých hub pro Čechy. *Česká Mykologie* 15: 201–205.
- Taheri H, Ershad D, Hallajisani MF, Gholamian E. 2008. Kiwifruit crown and root fungal pathogens in north of Iran. Proceedings of the 18th Iranian Plant Protection Congress, 24–27 Aug., Hamedan, Iran: 155.
- Zangeneh S, Maivan HZ. 1998. Investigation on the pine and cypress mycorrhiza in suburb parks of Tehran. Proceedings of the 13th Iranian Plant Protection Congress. Vol. II, 23–27 Aug., Karaj, Iran: 265.

قارچ‌های آگاریک و بولت در ایران: تنوع، سیستماتیک، و داده‌های nrDNA

معصومه قبادنژاد^۱، اوالد لانگر^۲، ولادیمیر آنتونین^۳، گنویو گیتس^۴، جلیل نوروزی^۵، رسول زارع^۶

۱- پژوهشکده بیوتکنولوژی، سازمان پژوهش‌های علمی و صنعتی ایران، تهران، ایران

۲- دانشکده اکولوژی، دانشگاه کاسل، کاسل، آلمان

۳- موزه تاریخ طبیعی موراوی، برنو، جمهوری چک

۴- موسسه کشاورزی تاسمانیا، تاسمانیا، استرالیا

۵- دانشکده تحقیقات گیاهی و تنوع زیستی، دانشگاه وین، وین، اتریش

۶- بخش تحقیقات رستنی‌ها، موسسه تحقیقات گیاه‌پزشکی کشور، سازمان تحقیقات، آموزش و ترویج کشاورزی، تهران، ایران

چکیده: در این تحقیق، اولین فهرست قارچ‌های آگاریک و بولت در ایران بر اساس منابع منتشره و نمونه‌های جدید ارائه می‌شود. در مجموع، ۱۲۸ توالی جدید DNA از ناحیه ریبوزومی ITS و همچنین از ناحیه LSU هسته با آغازگرهای مختلف بدست آمد. بر اساس نمونه‌های موثق بررسی شده و توالی DNA حاصل از بازیدیوم آنها، ۱۹ گونه برای اولین بار از ایران گزارش می‌شوند. بطور کلی این فهرست ۵۸۵ گونه (مشمول بر ۵۵۶ گونه آگاریک و ۲۹ گونه بولت) را از ایران معرفی می‌کند که متعلق به ۱۴۷ جنس، ۳۴ خانواده و شش راسته هستند. راسته Agaricales ۸۲٪ از گونه‌های این فهرست را دربرمی‌گیرد. بیست و هشت گونه نیز از فهرست میکوبایوتای ایران حذف می‌شوند. بخش عمده‌ای از گونه‌های معرفی شده در این تحقیق (۷۹٪) در جنگل‌های هیرکانی در شمال ایران رویش دارند و استان مازندران از نظر تعداد گونه‌ای (با ۲۴۴ گونه) در صدر استان‌های کشور قرار می‌گیرد. پرگونه‌ترین جنس‌های ایرانی به ترتیب عبارتند از جنس *Russula* با ۴۳ گونه، *Cortinarius* با ۲۶ گونه و *Inocybe* با ۲۵ گونه. همچنین تحقیق مفصلی در مورد توالی‌های DNA موجود از نمونه‌های ایرانی آگاریک و بولت در بانک ژن و پایگاه UNITE انجام شد. بر اساس این تحقیق، ۶۴ گونه در ایران حاصل توالی‌های محیطی (نوک ریشه) بوده و نه گونه نیز به صورت اندوفیت گیاهی جداسازی شده‌اند. در مجموع، تنها ۲۴٪ از گونه‌های آگاریک و بولت در ایران دارای حداقل یک توالی ITS در بانک ژن یا UNITE هستند. بررسی‌ها نشان داد که منبع گزارش ۴۲٪ از گونه‌های این فهرست صرفاً چکیده‌های ارائه شده در کنگره‌ها بوده است؛ اغلب این گزارش‌ها فاقد مشخصات کافی هستند و توصیه می‌شود که فعلاً بصورت آزمایشی تلقی شوند. نویسندگان این مقاله معتقدند که بارکد استاندارد DNA به روند شناسایی و تایید هویت قارچ‌های آگاریک و بولت در ایران سرعت خواهد بخشید و تعدادی توصیه عمومی جهت جلوگیری از پخش داده‌های مبهم و کم‌کیفیت را به جامعه قارچ‌شناسی پیشنهاد می‌کنند. این تحقیق بخشی از خلا مربوط به دانش قارچ‌های آگاریک و بولت در ایران را پر می‌کند و چارچوبی برای بررسی‌های تنوع زیستی و فیلوژنتیکی ارائه می‌دهد.

کلمات کلیدی: آگاریکومپست‌ها، فهرست، جنگل‌های هیرکانی، ماکروبازیدیومپست‌ها، قارچ‌های کلاهک‌دار، جنگل‌های زاگرس