



NEW INTERESTING RECORDS OF THREE SPECIES FROM PEZIZACEAE AND PYRONEMATACEAE FAMILIES (PEZIZALEA, ASCOMYCOTA) TO KURDISTAN REGION – IRAQ

Salah Abdulla Salih^{1*}, Adel Mohan Aday Al-Zubaidy, Hawrez Ali Nadir
and Marwa Hameed AlKhafaji²

¹*Plant Production Department- Technical college of Applied Sciences -Sulaimani Polytechnic University.

²Biology Department-College of Science- University of Baghdad

Abstract

The survey was carried out From January to April of 2018 on macrofungi samples collected from different places in Halabja province located in north eastern parts of Iraq-Kurdistan region. This region is rich in forest trees and pasture lands with diversity of shrubs and herbs and is expected to support the growth of several macro fungal species. However, this part of Kurdistan in Iraq is still unexplored from macrofungal point of view. In this paper three species from *Pezizaceae* and *Pyronemataceae* families that belonging to (*Pezizales*, *Ascomycota*), were reported from Iraqi Kurdistan. These macrofungal species are recorded for the first time from Iraq. Also the species were identified and showing their locations distributed on a map prepared for this purpose, and the photographs were taken of the specimens in which environment they grows.

Key words: *Pezizaceae*, *Pyronemataceae*, *Ascomycota*, Kurdistan region, Halabja province.

Introduction

Macro fungi can be defined as fungi that fruiting bodies form are greater than one centimeter in height or width (Bates, 2006) and further more defined as those fungi that produce fruiting bodies that can be seen clearly by naked eye which may be either epigenous or hypogenous (Mueller *et al.*, 2007; Devi and Shrivastava, 2016). In addition, the most of macro fungi dispersed throughout *Ascomycota*, *Basidiomycota* and *Zygomycota* are defined as those fungi which have large and easily observed spore-bearing structures that are formed above or below ground (Mueller *et al.*, 2007). Mushroom is one of the most important and biodiversity organism to inhabit and influence this planet. They are neither animal nor plant though some people consider them plants for various reasons, but they differ from plants in that they lack the green chlorophyll that plants use to manufacture their own food and energy. For this reason they are placed in a different Kingdom of their own. The true fungi belong to the kingdom Eukaryote that encompasses 4 phyla, 103 orders, 484 families and 4979 genera (Manoharachary

et al., 2005). A recent global study regarding macro fungal diversity estimated it to be within the range of 53,000 to 110,000 species (Mueller *et al.*, 2007). Also Lelley (2005) indicated that all the mushrooms which are used by man as very economic importance and the wild mushrooms are believed to be one of the most important non-wood forest products. Almost 3000 species or more have gastronomical uses and 100 or more have promising clinical activity against cancer and other chronic diseases. During the eighteenth century botanists made major progress in the identification and classification of the fungi, and the early microscopists observed and described hyphae and spores (Carlilie *et al.*, 2001). Ectomycorrhizal fungi are vital plant symbionts that improve plant nutrient status (Baxter & Dighton 2001). So there are diverse of Ectomycorrhizal fungi are comprised of an estimated 20000-25000 species (Rinaldi *et al.* 2008) from 66 lineages (Tedersoo *et al.* 2010). Furthermore, The order *Pezizales* (*Ascomycota*) includes morels and truffles, *Pezizales* are various and more distributed as symbionts in many ecosystems in particular that habitats subjected to drought (Gehring *et al.* 1998; Smith *et al.* 2007b) or frequent fires (Warcup 1990; Fujimura *et al.* 2005). Also

**Author for correspondence* : E-mail : salah.salh@spu.edu.iq

some *Peziza lesincrease* in response to disturbance and at forest edges (Dickie & Reich 2005; Tedersoo *et al.* 2006b). There are several *Pezizale* species illustrate some degree of affinity soils with high pH and for soil minerals (Petersen 1985; Tedersoo *et al.* 2006a; Garda-Montero *et al.* 2008; Iotti *et al.* 2010; Bonito *et al.* 2011). In addition, the *Pezizales* is characterized by operculate asci the monophyly of the order is not strongly supported. However, and many familial revisions have been proposed (O'Donnell *et al.*, 1997). Moreover, the group includes numerous independent lineages of truffles (O'Donnell *et al.* 1997) and as an order, it might be contains the majority of ectomycorrhizal species of ascomycetes. *Pezizaceae* and *Pyronemataceae* the two of best numerous in the Order *Pezizales* that *Pezizaceae* contains 31 genera with approximately 230 species (Kirk *et al.*, 2008). Also *Pezizaceae* have the great variation in ascometal forms. It includes taxa that produce epigeous, stipitate or sessile and cupulate, discoid, turbinate, pulvinate or sparassoid ascomata, or semi-hypogeous to hypogeous, some closed, folded to solid ascomata. The ascomata vary in size from a few mm to more than 10 cm in diameter and are often soft, fleshy and brittle. In terms of ecology of fungi the family covers a broad diverse of niches and fruiting on all kinds of sand, clay soil, or can be limestone, burnt ground, dung and wood. Moreover, some species are known to prefer soil with a high pH and in some cases a low content of organic matter (Petersen, 1985). So the family is primarily restricted to temp zones and arctic-alpine areas, although a few strictly tropical taxa are known. The genus *Peziza* is the largest genus within *Pezizales* with approximately 100 currently accepted species (Hohmeyer, 1986; Korf, 1972). It is a one of the interesting and complicated systematic complex and heterogeneous assemblage that constitutes the core of the family *Pezizaceae*. The European countries (Dissing, 2000), North America (Larsen & Denison, 1978), and South America (Gamundi *et al.*, 2004; Gammundi, 2010) have studied this group of fungi, whereas Africa, Asia, and Australia have given less attention to these fungi. One example of insufficient species diversity studies of *Peziza* is in Iraq. Unfortunately, as a whole, has been hardly studied in Iraq the only a few surveys concerning these species in this subject have been published. However, critical species diversity study or a taxonomic analysis of the *Peziza* is not carried out yet in Iraq. The genus *Peziza* includes taxa that produce cup-shaped, epigeous, sessile, pulvinate, cupulate, turbinate, or sparassoid apothecia. The apothecia is diverse in size and forms from a few millimeters to more than 10 centimeters in diameter, and are often soft and fleshy. The most species are separated from each other mainly

on the basis of their micro structural and biochemical characters such as spore shape, color, ornamentation, and guttulation amyloid reaction of the ascus; pigmentation of the paraphyses and excipulum structure. Also ecologically the genus covers on all types of soil either sandy or clay, limestone and grows on dead wood. According to Petersen (1985), the most *Peziza* species prefer alkali soil and in some cases a low content of organic matter. The majority of species are considered to be saprotrophs and only a few species are claimed to be ectomycorrhizal (Maia *et al.*, 1996). Based on Alkhesraji (2012), the *Pezizaceae* species classification is as follows:

Kingdom : *Myceteae*

Division : *Amastigomycota*

Subdivision : *Ascomycotina*

Class : *Ascomycetes*

Subclass : *Hymenoascomycetidae*

Order : *Pezizales*

Family : *Pezizaceae*

Genus : *Peziza*

Species : *Peziza badia*, *Peziza repanda*

Pyronemataceae family is the largest belonging to *Pezizales* that including 78 genera representing approximately half of the known species within the order (Hansen & Pfister 2006). According to (Kirk *et al.* 2008; Perry *et al.* 2007) that *Pyronemataceae* includes approximately 80 genera and around 660 species. In terms of this fungi ecology it includes epigeous, semi – hypogeous to hypogeous species that cover and quite broad vary of niches, fruiting on all types of soil and in wood lands or burnt ground (Liu & Zhuang, 2006a). The ascoma morphology is highly diverse, including discoid, pulvinate and cupulate the apothecia as well as hypogeous ptychothecial and stereotypical ascomata (Burdall, 1968; Perry *et al.* 2007). The most species are saprotrophic an increasing proportion is identified as ectomycorrhizal symbionts (Laessoe & Hansen 2007). In addition, the *Pyronemataceae* family have been taxonomically argumentative as they are not conjunct by common morphological traits neither macro- nor microscopically (Perry *et al.* 2007). While the positioning of many genera has recently been resolved with confidence within *Pyronemataceae* (Hansen & Pfister 2006; Laessoe & Hansen 2007; Perry *et al.* 2007), the problem of species recognition and diversity of species estimates particularly for the sequestrate genera which has attracted much less attention (Guevara-Guerrero *et al.* 2012). Based on Alkhesraji (2012), the *Pyronemataceae* species classification

is as follows:

Kingdom : *Myceteae*
Division : *Amastigomycota*
Subdivision : *Ascomycotina*
Class : *Ascomycetes*
Subclass : *Hymenoascomycetidae*
Order : *Pezizales*
Family : *Pyronemataceae*
Genus : *Geopora*
Species : *Geopora sumneriana*

In Iraq there are only a few surveys conducted for these species in this subject have been published. The most notable ones include the elaborations by Farid *et al.* (2013). However, critical species diversity study or a taxonomic analysis of the *Peziza* is not carried out yet in Iraq. The species were collected in around Halabja city of Sulaimani district, expanding the occurrence records of these species in Iraqi Kurdistan region. The taxonomic treatment from the species are follows Al-khesraji, (2012). Halabja province located in north eastern parts of Iraq in Iraqi Kurdistan region has a mild and rainy climate in spring and autumn, providing approximate ideal conditions for fungal growth and the temperatures ranging between 8 and 25°C. Only a few people in this province know edible wild mushrooms and are able to identify them. It is necessary to have some basic information to avoid the poisoning associated with some of the mushrooms. Kurdistan of Iraq is with a cold winter (December – March or April) and relatively high rainfall upwards to 800 mm and the mountains above approximately the 1800 m level are snowbound for several months and snows often falls in the valleys, while the summer though hot and dry, is comparatively of shorter duration (June to September) than on the other parts of Iraq (May to October). These factors contribute to richer biodiversity situation especially the floral components (Lahonyet *al.*, 2013). There are no previous studies on this families in Iraq except to mention it by Faridet *al.*, (2013) reported the distribution of the species *Peziza echinospora* in the Erbil district. The aim of this paper is to record three new species of Ascomycetes macrofungi that *Pezizaceae* is two species belonging to the family and one species belonging to Pyronemataceae family to Iraq at the first time. Moreover, the Pyronemataceae family did not register previously and this study will be the first to record it and add this family to Iraqi Fungi.

Material and methods

The research was carried out during year 2018 in

diverse places of Halabja province Kurdistan regional government-Iraq. The survey involved 9 location around Halabja province (Bawakochak, Trefa, Presi Khwaru, PresiSarw, Gorga chia, Anab, Ababele, Jalleela, Zamaqe). The fields of collection located between (35° 13' 7.1076" N, 45° 53' 31.7148" E and 35° 12' 31.554" N, 46° 0' 50.544" E). These places are more liable to grow fungi because of wet and include conifer forest, stream, lawn, grasslands and pasture land. However, the three species were recorded in this study found only in three location that (Anab, Gorga chia and Jalleela). The methods of collection were carried out by keeping the specimens in a bag with label until lab beside the collection each specimen has been photographed in colored by digital camera, also the information about the habitat and features of each specimens morphologically have been recorded to which is used during identification. The identification of fungi are recorded depending on the morphological characteristic of fungi which include (The shape of cap and size, gills color with spacing lamellules and different illustration like sieve gills, the stem to the caps with rings or without, the stem size, shape, surface texture, the presence or absence) and the habitat which mushroom found. The various methods have been used of identification the specimens (Dennis *et al.*, 2016; Al-khesraji, 2012; Michael *et al.*, 2011, McKnight *et al.*, 1987) most of these books contains key for species and illustrations which help for identification.

Result and Discussion

During the survey of different sites of Halabja province, three macrofungal species were found. The fungi species are considered as new records to Iraq fungi. The taxonomic description, distribution and description of fungi body with photos are given below.

1. Family: *Pezizaceae*

Peziza repanda pers.

Taxonomic Description: Pers. Icon. Rari. Pict. Fung. 4. 49. *Peziza repanda amplispora* Cooke & Peck; Cooke, Bull. Buffalo Acad. Sci. 2: 288 (1875). *Peziza pallidula* Cooke & Peck; Cooke, Bull. Buffalo Acad. Sci. 2: 288. (1875). *Aleuria repanda* . Pers. Gillet, Champ. Fr., Discom.:43 (1879); *Discina repanda* (Pers.) Sacc., Syll. Fung., 8: 100 (1889); *Plicaria repanda* Pers. Rehm, Rabenh. Krypt.-Fl., 3: 1007 (1896); *Cellularia repanda* (Pers.) Kuntze, Revis. Gen. Pl., 3 (2):452 (1898); *Peziza linteicola* W. Phillips & Plowr., Man. Brit. Discom.: 64 (1887). = *Aleuria varia f. terrestris* Bres., *Fungi Tridentini*, 2: 76 (1898). *Peziza varia f. lignicola* Bres. Fungi Trid. 2:76 (1898). *Pustularia Stevensoniana* Rehm; Rab. Krypt.-Fl. 13: 119 (1896). *Plicaria repanda*

Rehm; Rab. Krypt.-Fl. 13:007 (1896). *Geopyxi samplispora* Sacc. Syll. Fung. 8: 71. (1889). *Geopyxi spallidula* Sacc. Syll. Fung. 8: 70 (1889). *Peziza stevensoniana* Ellis; Rehm Ascom. Lojk. 3 (1882). *Peziza amplispora* Cooke, Mycographia 167 (1877). (Seaver, 1916).

Habitat and distribution : This mushroom is found in spring that grow on well-decayed logs, it is found on the wood of hardwoods in particular on wood chips or on the ground in soil that is rich with decayed wood gregariously growing alone, or as a group typically found in colder weather (Fig. 1).

The body description : Apothecia sessile or very short and cup-shaped, the margin even or crenate the outer of cup is white or whitish expanding and becoming repand also the margin of cup remaining entire or splitting, regular in outline or revolute irregularly (Fig. 2). The cup



Fig.1: The environment of *Peziza repanda*



Fig. 2: The cup of *Peziza repanda*.



Fig. 3: The outer cup of *Peziza repanda*.

reaching of 6-12 cm across in diameter and the stem short a few mm when carry the fungus it remains within the tree that attached, (attached to the substrate centrally not all cup attached to the tree), the color of cup is upper surface smooth and brown often pinched or somewhat wrinkled over the center also under surface whitish and somewhat fuzzy becoming darker with age, even or convolute (Fig.3).

Peziza badia pers

Taxonomic Description: Pers., Observ. Mycol., 2: 78 (1800). *Plicaria badia*(Pers.) Fuckel, Jb. Nassau. Ver. Naturk., 23-24: 327 (1870) ;*Galactinia badia* (Pers.)Arnould, Bull. Soc. mycol. Fr., 9: 111 (1893).(Barseghyan, 2011)

Habitat and distribution: This mushroom is found in grass which is found in a group of mushrooms. The mushroom found in March after heavy raining in Gorga chia at Halabaj province. (Fig.4)



Fig. 4: The habitat tof *Peziza badia*.

The body description: Shallow cup-shaped structure that 3–7.5 cm wide, margin often wavy. This kind of mushroom are sessile and the lower surface is sterile that color dark brown to purplish brown and somewhat scurfy also the upper surface is fertile with



Fig. 5: The body fruit of *Peziza badia*.

2. Family: Pyronemataceae

Geopora sumneriana (Cooke) M. Torre.

Taxonomic Description: Cooke (1879) pl. 29 fig. 111 sub nom. *Peziza lanuginosa* var. *sumneri*; Boudier (1910, pl. 358) sub nom. *Sepultaria sumneri*; Breitenbach & Kränzlin (1984, pl. 68) sub nom. *Sepultaria sumneri*; Cetto (1976, pl. 815) sub nom. *Sepultaria sumneri*; Dennis (1978, pl. VIII F) sub nom. *Sepultaria sumneri*; Moreno et al. (1986, fig. 25.); Courtecuisse & Duhem (1994, pl. fig. 38); Medardi (2006 p. 64); Fouchier & Neville (1998). (Cooke) M. Torre 1975, Ann. Inst. Bot. Cavanilles 32: 96 = *Peziza sumneriana* Cooke, Mycographia 1: 63, fig. 111 1879. = *Peziza lanuginosa* var. *sumneriana* Berk. & Broome, Ann. Mag. Nat. Hist. Ser. 3. 18; 125. + pl. 396, fig. 2, (1866). = *Sepultaria sumneriana* (Cooke), Masee, Brit. Fung.-Fl. 4: 391, (1895). = *Lachnea sumneriana* (Cooke) W. Phillips, Discomycetes: 213-214, (1887). = *Sepultaria sumneri* (Berk.) Boudier, Hist. classific. discomyc. Europe: (1907). (Periæ, 2011)

Habitat and distribution: This fungus was found under conifer trees in forest inside soil were covered by leaves of conifers. In Galeela village near Halabja province (Fig.6).



Fig.6: The habitat *Geopora sumneriana*

The body description: the cup nearly 5-7 cm across closed then opened, sessile, initially, just below the soil surface, with visible reddish brown mycelium in base. After maturation a small hole opens up on top, with properly margin then when it is dry breaking through and splitting into several recurring lobes becomes an open bowl (Fig.7). The Hymenium of fungus is smooth whitish grayish and at last cream. The outer is brown is covered with dense brown wool it is also Fleshy thick (1-2 mm) (Fig.7).



Fig. 7: The body of *Geopora sumneriana*.

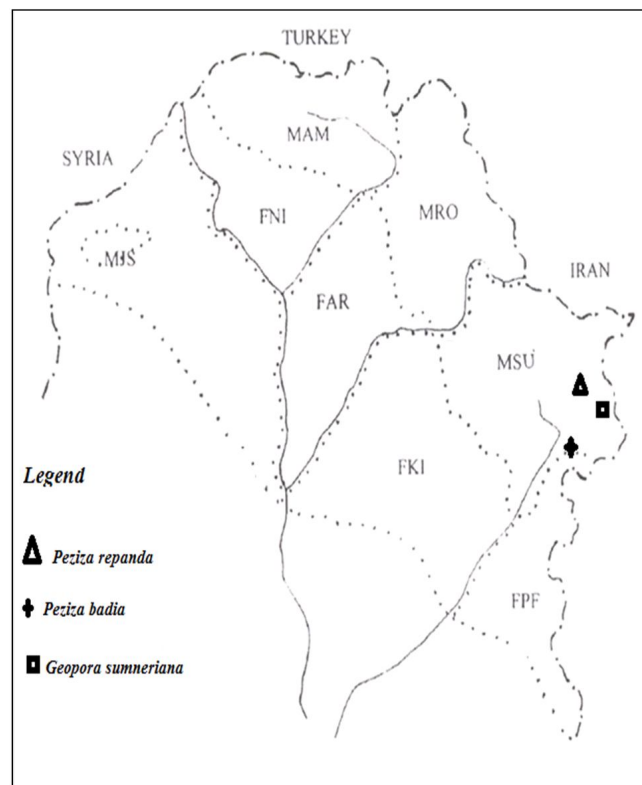


Fig. 8: Map of the distribution of studded species in Halabja province.

Conclusion

To conclude that Iraqi Kurdistan is considered as a place for growth and development diversity of macrofungi because of that climatic conditions are appropriate. This region is still rich in conducting more survey to find new species of macrofungi. Hence further survey of this group of fungi in this region is of great importance towards creating a checklist of macrofungi in Iraq. So that this research is important in diagnosing and identifying the species of macro fungi that distributed in the different area of Halabja province and the recording of new species of these fungi for the first time in Iraq.

References

- Al-khesraji Talib, O. (2012). *The Fungi*. 385p.
- Barseghyan, G.S. and P. Solomon (2011). The genus *Peziza* Dill. ex Fr. (*Pezizales*, Ascomycota) in Israel. *Ascomycete Org*, **2(4)**: 39-50.
- Bates, S.T. (2006). A preliminary checklist of Arizona macrofungi. *Canotia*, **2(2)**: 47-78.
- Baxter, J.W. and J. Dighton (2001). Ectomycorrhizal diversity alters growth and nutrient acquisition of grey birch (*Betula populifolia*) seedlings in host-symbiont culture conditions. *New Phytologist*, **152**: 139-149.
- Bonito, G., T. Breneman and R. Vilgalys (2011). Ectomycorrhizal fungal diversity in orchards of cultivated pecan (*Carya illinoensis*; Juglandaceae). *Mycorrhiza*, **21**: 601-612.
- Burdall, H.H. (1968). A revision of the genus *Hydnocystis* (Tuberales) and of the hypogeous species of *Geopora* (*Pezizales*). *Mycologia*, **60**: 496-525.
- Carlile, M.J., S.C. Watkinson and G.W. Gooday (2001). *The fungi*. Gulf Professional Publishing.
- Dennis, E., Desjardin, Michael G. Wood and A. Stevens Frederick (2016). *California Mushrooms: The Comprehensive Identification Guide*. Timber Press.
- Devi, K. and K. Shrivastava (2016). Diversity of macrofungi in 'Jalukbari Reserve Forest' of Kamrup District, Assam. *Adv. Appl. Sci. Res.*, **7(1)**: 115-119.
- Dickie, I.A. and P.B. Reich (2005). Ectomycorrhizal fungal communities at forest edges. *Journal of Ecology*, **93**: 244-255.
- Dissing, H. (2000). *Pezizales*. In: Hansen L, Knudsen H, eds. *Nordic macromycetes 1*. Copenhagen: Nordsvamp. 300p.
- Farid, M. Hero Toma, M. Ismael and Q. Faqi Abdulla Nareen (2013). Survey and Identification of Mushrooms in Erbil Governorate. *Research Journal of Environmental and Earth Sciences*, **5(5)**: 262-266.
- Fujimura, K., J. Smith, T. Horton and N. Weber (2005). *Peziza* ectomycorrhizas and sporocarps in ponderosa pine (*Pinus ponderosa*) after prescribed fires in eastern Oregon, USA. *Mycorrhiza*, **15**, 79-86.
- Gamundi, I.J., D.W. Minter, A.I. Romero, V.A. Barrera, A.L. Gaiotti, M.I. Messuti and M. Stecconi (2004). Checklist of the Discomycetes (Fungi) of Patagonia, Tierra del Fuego and adjacent Antarctic areas. *Darwiniana*, **42(1-4)**: 63-164.
- Gamundi, I.J. (2010). Genera of *Pezizales* of Argentina 1. An updating of selected genera. *Mycotaxon*, **113**: 1-60.
- Garda-Montero, L.G., P. Diaz, S. Maron-Fernandez and M.A. Casermeiro (2008). Soil factors that favour the production of *Tuber melanosporum* carpophores over other truffle species: a multivariate statistical approach. *Acta Agriculturae Scandinavica Section B Soil and Plant Science*, **58**: 322-329.
- Gehring, C., T. Theirner, T. Whitham and P. Keim (1998). Ectomycorrhizal fungal community structure of pinyon pines growing in two environmental extremes. *Ecology*, **79**: 1562-1572.
- Guevara-Guerrero, G., B. Stielow, H. Tamm, E. Cázares-Gonzalez and M. Göker (2012). *Genea mexicana*, sp. nov., and *Geopora toluicana*, sp. nov., new hypogeous Pyrenomataceae from Mexico, and the taxonomy of *Geopora* reevaluated. *Mycological progress*, **11(3)**: 711-724.
- Hansen, K. and D.H. Pfister (2006). Systematics of the Pezizomycetes – the operculated discomycetes. *Mycologia*, **98(6)**: 1029-1040.
- Hohmeyer, H. (1986). Ein Schlüssel zu den europäischen Arten der Gattung *Peziza* L.. *Z Mykol*, **52**: 161-188.
- Iotti, M., E. Lancellotti, I. Hall and A. Zambonelli (2010). The ectomycorrhizal community in natural *Tuber borchii* grounds. *FEMS Microbiology Ecology*, **72**: 153-310.
- Kirk, P.M., P.F. Cannon, D.W. Minter and J.A. Stalpers eds. (2008). *Dictionary of the Fungi* (10th ed.). Wallingford, UK: CAB International. ISBN 978-0-85199-826-8.
- Korf, R.P. (1972). Synoptic key to the genera of the *Pezizales*. *Mycologia*, **64**: 937-994.
- Laessle, T. and K. Hansen (2007). Truffle trouble: what happened to the Tuberales. *Mycological Research*, **111**: 1075-1099.
- Lahony, S.R.A., M.K. Mohammad, H.H. Ali, A.A. AL-moussawi and M.S.A. AL-Rasul (2013). Hawraman lowest zone, Kurdistan province north east of Iraq. *Bull. Iraq Nat. Hist. Mus.*, **12**: 7-34.
- Larsen, H.J. Jr. and W. Denison (1978). A checklist of the operculate cup-fungi (*Pezizales*) of North America west of the Great Plains. *Mycotaxon*, **7(1)**: 68-90.
- Lelley, J.I. (2005). Modern applications and marketing of useful mushrooms. *International Journal of Medicinal Mushrooms*, **7(1&2)**.
- Liu, C.Y. and W.Y. Zhuang (2006). Phylogeny of some genera in the Pyrenomataceae (*Pezizales*, Ascomycetes). *Mycosystema*, **25(4)**: 546-558.
- Manoharachary, C., K. Sridhar, R. Singh, A. Adholeya, T.S. Suryanarayanan, S. Rawat and B.N. Johri (2005). Fungal biodiversity: distribution, conservation and prospecting of fungi from India. *Current Science*, 58-71.
- Maia, L.C., A.M. Yano and J.W. Kimbrough (1996). Species of Asco-mycota forming ectomycorrhizae. *Mycotaxon*, **57**: 371-390.
- McKnight, Kent H. McKnight and B. Vera (1987). *A field guide to mushrooms, North America 3rd edition.*; Boston : Houghton Mifflin,
- Mueller, G.M., J.P. Schmit, P.R. Leacock, B. Buyck, J. Cifuentes, Desjardin *et al.* (2007). Global diversity and distribution of macrofungi. *Biodivers. Conserv.*, **16**: 37-48.
- Michael, D.E., Anderson Ostry, A. O'Brien Neil and G. Joesph

- (2011). Field guide to common macrofungi in eastern forests and their ecosystem functions.; *Gen. Tech. Rep. NRS-79*.
- O'Donnell, K., E. Cigelnik, N. Weber and Y J. M. Trappe (1997). Phylogenetic relationships among ascomycetous truffles and the true and false morels inferred from 18s and 28s ribosomal DNA sequence analysis. *Mycologia*, **89**: 48-65.
- Periæ, B. and O. Periæ (2011). Notes on Montenegrin species of *Geopora*. *Mycologia Montenegrina*, **14**.
- Perry, B.A, K. Hansen, D.H. Pfister (2007). A phylogenetic overview of the family Pyronemataceae (*Ascomycota*, *Pezizales*). *Mycological Research*, **111**, 549-571.
- Petersen, P.M. (1985). The ecology of Danish soil inhabiting *Pezizales* with emphasis on edaphic conditions. *Opera Bot*, **77**: 1-38.
- Rinaldi, A.C., O. Comandini and T.W. Kuyper (2008). Ectomycorrhizal fungal diversity: separating the wheat from the chaff. *Fungal diversity*, **33**: 1-45.
- Seaver, F.J. (1916). Photographs and Descriptions of Cup-Fungi: III. *Peziza domiciliana* and *Peziza repanda*. *Mycologia*, **8(4)**: 195-198.
- Smith, M., G.W. Douhan and O.M. Rizzo (2007). Ectomycorrhizal community structure in a xeric *Quercus* woodland based on rDNA sequence analysis of sporocarps and pooled roots. *New Phytologist*, **174**: 847-863.
- Tedersoo, L., A. Sadam, M. Zambrano, R. Valencia and M. Bahram (2010). Low diversity and high host preference of ectomycorrhizal fungi in Western Amazonia, a neotropical biodiversity hotspot. *The ISME journal*, **4(4)**: 465.
- Tedersoo, L., K. Hansen, B. Perry and R. Kjoller (2006). Molecular and morphological diversity of *peziza leanectomycorrhiza*. *New Phytologist*, **170**: 581-596.
- Tedersoo, L., T. Suvi, E. Larsson and U. Koljalg (2006). Diversity and community structure of ectomycorrhizal fungi in a wooded meadow. *Mycological Research*, **110**: 734-748.
- Tedersoo, L., T. May and M. Smith (2010). Ectomycorrhizal life style in fungi: global diversity, distribution, and evolution of phylogenetic lineages. *Mycorrhiza*, **20**: 217-263.
- Warcup, J.H. (1990). Occurrence of ectomycorrhizal and saprophytic discomycetes after a wild fire in a eucalypt forest. *Mycol Res*, **94**: 1065-1069.