

## Lepiotaceous fungi (Agaricaceae) in the Iranian part of Caucasia

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**Abstract:** In this research, lepiotaceous fungi belonging to the family Agaricaceae were collected and identified from the Iranian part of Caucasia. As a result of these investigations, 14 species belonging to 6 genera (*Chlorophyllum* Masee, *Cystolepiota* Singer, *Lepiota* (Pers.) Gray, *Leucoagaricus* Locq. ex Singer, *Leucocoprinus* Pat., and *Macrolepiota* Singer) were identified. Of the species identified, *Chlorophyllum molybdites* (G.Mey.) Masee, *Cystolepiota seminuda* (Lasch) Bon, *Lepiota clypeolarioides* Rea, *Lepiota felina* (Pers.) P.Karst., and *Leucocoprinus ianthinus* (Cooke) P.Mohr are new for Iranian fungus biota.

**Key words:** Biodiversity, Caucasus area, taxonomy

### Introduction

Caucasia is a region with a total area of 580,000 km<sup>2</sup> (58 million ha) that consists, in full or in part, of 6 countries: Armenia, Azerbaijan, Georgia, Russia, Turkey, and Iran. Caucasia is one of the most biologically rich regions and is ranked among the planet's 25 most diverse and endangered hotspots. It is a hotspot of plant and animal diversity and endemism, and it is located at a biological crossroads between species from central and northern Europe, central Asia and the Middle East, and North Africa, with endemics found nowhere else.

The Iranian part of Caucasia has a total area of 3 million ha and includes 2 major regions (corridors), Arasbaran and Hyrcan, that constitute the southern

stretches of the Caucasus (Transcaucasia) (Asef, 2009).

The Hyrcan Corridor (1.85 million ha) includes the Talysh Mountains and the north-western part of the Alborz Mountains along with a section of the Caspian coast and the provinces of Gilan and Ardebil. The Hyrcanic region is 1 of the 2 important plant refuges in the Caucasus hotspot, where a number of endemic species are found. Major habitats include broadleaf forests, high mountain steppes, meadows, and some coastal wetlands (Asef, 2009).

Lepiotaceous fungi comprise the white- and green-spored members of Agaricaceae belonging to the genera *Chamaemyces* Earle, *Chlorophyllum* Masee, *Cystolepiota* Singer, *Endoptychum* Czern.,

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*Lepiota* (Pers.) Gray, *Leucoagaricus* Locq. ex Singer, *Leucocoprinus* Pat., *Macrolepiota* Singer, and *Melanophyllum* Velen. (Vellinga, 2001, 2002, 2004).

There have been sparse reports on macrofungi in the Iranian parts of Caucasia, but there is still no comprehensive study on the macrofungi of this region. Some recent studies on the biodiversity and taxonomy of macrofungi in the Iranian part of Caucasia have provided data on the diversity of fungi in the Caucasus hotspot (Asef et al., 2007, 2008; Asef, 2008a, 2008b, 2009).

The objective in this study was to investigate the poorly known lepiotaceous group of fungi in the Iranian part of Caucasia, a far less investigated area.

### Materials and methods

Fungal specimens used in this study originated from field samples collected from the Iranian part of Caucasia by the first author as well as specimens from the fungal herbarium of the Iranian Research Institute of Plant Protection (fungus collection of the Ministry of Agriculture - IRAN).

Specimens were studied in distilled water and Melzer's reagent. Specimens were described based on characters observed in fresh and dried basidiocarps. Microstructures were studied using an Olympus microscope and spore prints were obtained by placing pilei over sterile paper. All of the samples were kept in the fungus collection of the Ministry of Agriculture (IRAN).

### Results

*Chlorophyllum molybdites* (G.Mey.) Masee, Bull. Misc. Inf., Kew: 136 (1898).

Pileus 6-20 cm, ovoid to hemispherical at first becoming convex to plano-convex with age, sometimes with a low umbo at disc, white to whitish, covered with light brown, brown, to pinkish brown scales, scales concentrated toward the centre, disc smooth, brown. Lamellae free, broad, whitish when young, then greenish to green when mature. Stipe whitish, equal or thicker at base, 50-200 × 8-15 mm, veil, membranous, white, forming 2 rings, rings becoming brownish on underside, context whitish, becoming reddish brown when cut. Spore print green.

Spores 8.5-11.5 × 6.5-8.5 µm, elliptical, thick-walled, smooth, light olive-green, dextrinoid, with an apical germ pore. Basidia 27-36 × 10-15 µm, clavate, hyaline, 4-spored, pleurocystidia absent. Cheilocystidia numerous, broadly clavate, 21-40 × 10-20 µm, with brownish vacuolar pigment (Figure 1). Pileipellis with hyphae with terminal elements, clavate to subfusiform, 8-16 µm in diameter, with brown to dark brown vacuolar pigment.

Materials examined: East Azarbaijan, Arasbaran forests, 2003/10/19, on soil (ASEF 1234); East Azarbaijan, Arasbaran forests, Aynalou, 2004/10/09, on soil (ASEF 989); East Azarbaijan, Arasbaran forests, Makidi, 2005/10/12, on soil (ASEF 1031).

It is most likely to be mistaken for some large lepiotaceous fungi (*Macrolepiota* species), but the green spore print make the species quite characteristic.

*Chlorophyllum rhacodes* (Vittad.) Vellinga, Mycotaxon 83: 416 (2002).

Gilan, Pimbra, Asalem, 1974/09/18, on soil (IRAN 9383) (as *Macrolepiota rhacodes*); Gilan, Shanderman, 1987/08/28, on soil (IRAN 9441) (as *Macrolepiota rhacodes*).

Results of studies by Vellinga et al. (2003) on the basis of both molecular evidence from DNA sequences and on the similarities in morphology transferred *M. rhacodes* to the genus *Chlorophyllum*.

*Cystolepiota seminuda* (Lasch) Bon, Docums Mycol. 6: 43 (1976).

Pileus 1-3 cm, convex to plano-convex, white with reddish grey centre, powdery mealy. Lamellae free, close, whitish to pale pinkish. Stipe 20-50 × 1-3 mm, whitish above, pinkish below, equal or slightly thicker below, smooth or powdery mealy, veil evanescent, leaving remnants on the pileus margin, but not a distinct ring. Context whitish. Spore print white.

Spores 3.5-5 × 2-3.5 µm, elliptical, smooth, nondextrinoid, without germ pore. Basidia 27-36 × 10-15 µm, clavate, hyaline, 4-spored. Cheilocystidia and pleurocystidia absent (Figure 1).

Materials examined: Gilan, Fooman, Gasht Roudkhan, 2008/10/13, on soil (IRAN 13587); Gilan, Masal, Chesli, 2008/10/14, on soil (ASEF 1129).

The species was mainly distinguished by colour of pileus, mealy coating of fruit body, and having nonamyloid basidiospores.

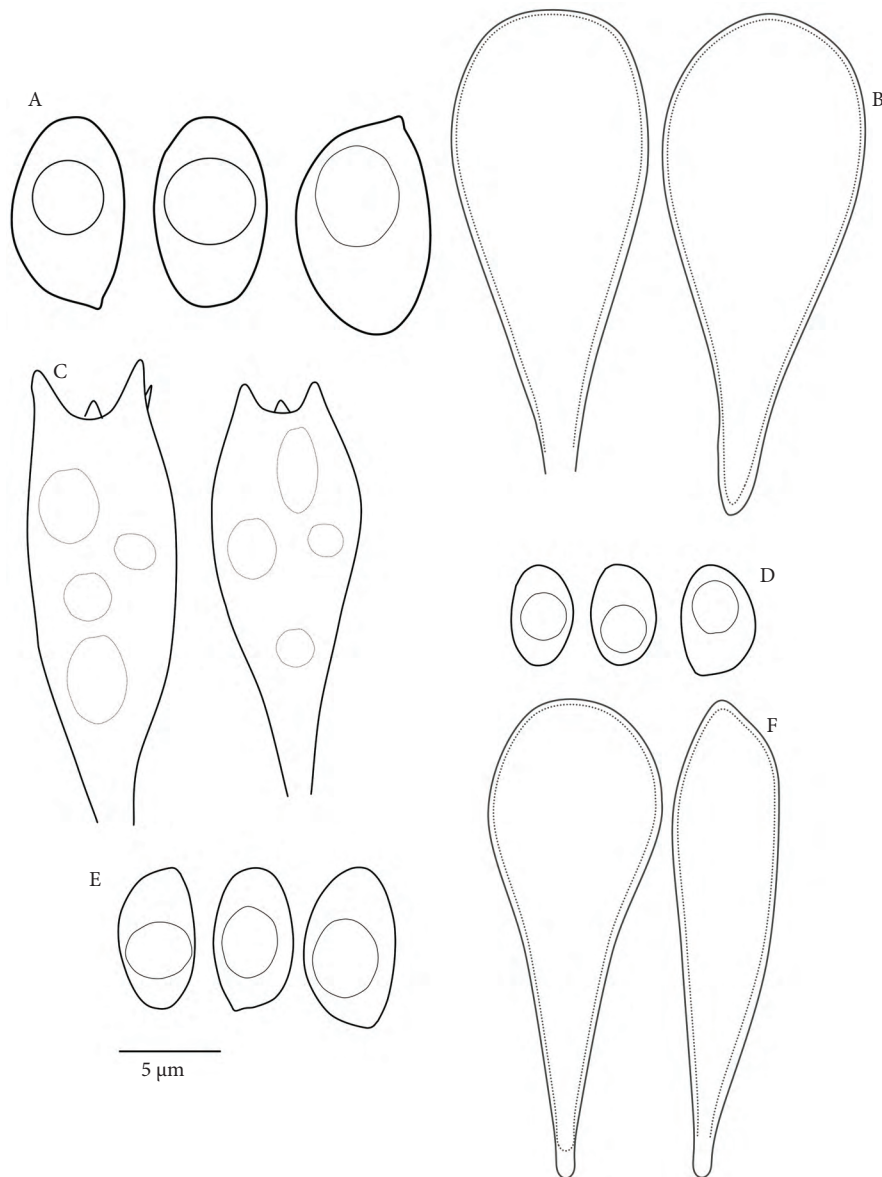


Figure 1. *Chlorophyllum molybdites*: A- spores, B- cheilocystidia. *Cystolepiota seminuda*: C- basidia, D- spores. *Lepiota clypeolarioides*: E- spores, F- cheilocystidia.

***Lepiota aspera*** (Pers.) Quél., Enchir. Fung. (Paris): 5 (1886).

Materials examined: Gilan, Asalem, 1994/09/21, on soil (IRAN 9352) (as *Lepiota acutesquamosa*); Gilan, Asalem, Pisason forest, 1985/10/08, on soil (IRAN 9349) (as *Lepiota acutesquamosa*); Gilan, Bargol, Rasht, 1985/10/09, on soil (IRAN 9350) (as *Lepiota acutesquamosa*); Gilan, Talesh, 2008/10/13, on soil (ASEF 1117).

***Lepiota castanea*** Quél., Compt. Rend. Assoc. Franç. Avancem. Sci. 9: 661 (1881).

Materials examined: East Azarbaijan, Arasbaran forests, 2003/10/18, on soil (IRAN 11934); East Azarbaijan, Arasbaran forests, Aynalou, 2004/10/07, on soil (ASEF 980); East Azarbaijan, Arasbaran forests, Makidi, 2005/10/12, on soil (ASEF 1001).

***Lepiota clypeolarioides*** Rea, Brit. Basidiomyc. (Cambridge): 69 (1922).

Pileus 2-5 cm, convex to broadly convex with low umbo, white with ochre to rusty scales. Lamellae free, white, close. Stipe 20-50 × 2-5 mm, white, slender, with broad membranous ring and ring zone below ring. Context white. Spore print white.

Spores 6-7.5 × 4-4.5 μm, smooth, strongly to weakly dextrinoid, ovoid-ellipsoid, with a convex curve on each side. Cheilocystidia subfoid or clavate, cells of cap cuticle subcylindrical and 75-110 μm long, with clamp connection. Pleurocystidia absent. Clamp connections present (Figure 1).

Materials examined: Gilan, Siahkal to Deilaman, 2008/10/16, on soil near conifers (IRAN 13645); Gilan, Siahkal, 2008/10/16, on soil near conifers (ASEF 1124).

Stipe with broad membranous ring and ring zone below ring, ovoid-ellipsoid spores and spore size make the species quite characteristic compared to other close species such as *L. felina* (Pers.) P.Karst. and *L. clypeolaria* (Bull.) P.Kumm.

***Lepiota cristata*** (Bolton) P.Kumm., Führ. Pilzk. (Zwickau): 137 (1871).

Materials examined: Gilan, Fooman to Masooleh, 1994/11/01, on soil (IRAN 9355); Gilan, Fooman, Gasht Roudkhan, 2008/10/13, on soil (IRAN 13561); East Azarbaijan, Arasbaran forests, Kalaleh, 2004/10/09, on soil (IRAN 3192).

***Lepiota eriophora*** Peck. Bulletin of the Torrey Botanical Club 30: 95 (1903).

Material examined: Gilan, Fooman, Gasht Roudkhan, 2008/10/13, on soil (IRAN 13560).

***Lepiota felina*** (Pers.) P.Karst., Rysslands, Finlands och den Skandinaviska Halföns. Hattsvampar: 10 (1879).

Pileus 2-3 cm, broadly convex and slightly umbonate, with dark brown to almost black scales on white background. Lamellae free, white. Stipe 30-50 × 2-4 mm, fibrillose, white with blackish scales in lower part of the ring; ring membranous, white on upper surface, dark brown below. Context white, becoming tinged brownish. Spore print white.

Spores 6.5-8 × 3.5-4.5 μm, ovoid. Cheilocystidia thin-walled, clavate to fusiform, hyaline (Figure 2).

Materials examined: Gilan, Fooman, Masal, Shalma, 2008/10/14, on soil (IRAN 13642); Gilan, Fooman, Masasl, Shalma, 2008/10/14, on soil (IRAN 13643); Gilan, Fooman to Masooleh, 2008/10/13, on soil, (IRAN 13619); Gilan, Shafarood, 2008/10/15, on soil (IRAN 13620); Gilan, Rasht, Saravan, 2008/10/13, on soil, (IRAN 13644).

This species is recognised by its white cap with dark brown to black scales.

***Leucoagaricus leucothites*** (Vittad.) Wasser, Ukr. Bot. Zh. 34(3): 308 (1977).

Materials examined: Gilan, Asalem forests, 1987/08/28, on soil (IRAN 9407); Gilan, Fooman, Gasht Roudkhan, 2008/10/13, on soil (ASEF 1123).

***Leucocoprinus brebissonii*** Godey, Bull. Mens. Soc. Linn. Lyon 12: 95 (1943).

Materials examined: Gilan, Shanderman, 1987/08/28, on soil, (IRAN 13587); Gilan, Masal, Chesli, 2008/10/14, on soil (ASEF 1141); Gilan, Talesh, 2008/10/13, on soil (ASEF 1115).

***Leucocoprinus ianthinus*** (Cooke) P.Mohr, Boletus 18(2): 48 (1994).

Pileus 1-3 cm, ovoid to campanulate at first becoming convex to plano-convex with violet umbo at disc, pink to pale lilac, covered with pinkish brown to purple scales, scales concentrated toward the centre. Lamellae free, whitish when young, then pink. Stipe 30-60 × 2-4 mm, whitish above, pale lilac below. Ring white. Context whitish, becoming reddish brown when cut.

Spores 8.5-10 × 5.5-7.5 μm, ovoid, smooth, light olive-green, dextrinoid, with an apical germ pore (Figure 2). Basidia 27-36 × 10-15 μm, clavate, hyaline, 4-spored. Pileipellis with hyphae with terminal elements, clavate to subfusiform, 8-16 μm in diameter, with brown to dark brown vacuolar pigment.

Materials examined: Gilan, Fooman, Gasht Roudkhan, 2008/10/13, on soil (IRAN 13583); Gilan, Masal, Chesli, 2008/10/14, on soil (IRAN 13583).

The species was mainly distinguished by pink to pale lilac pileus covered with pinkish brown scales.

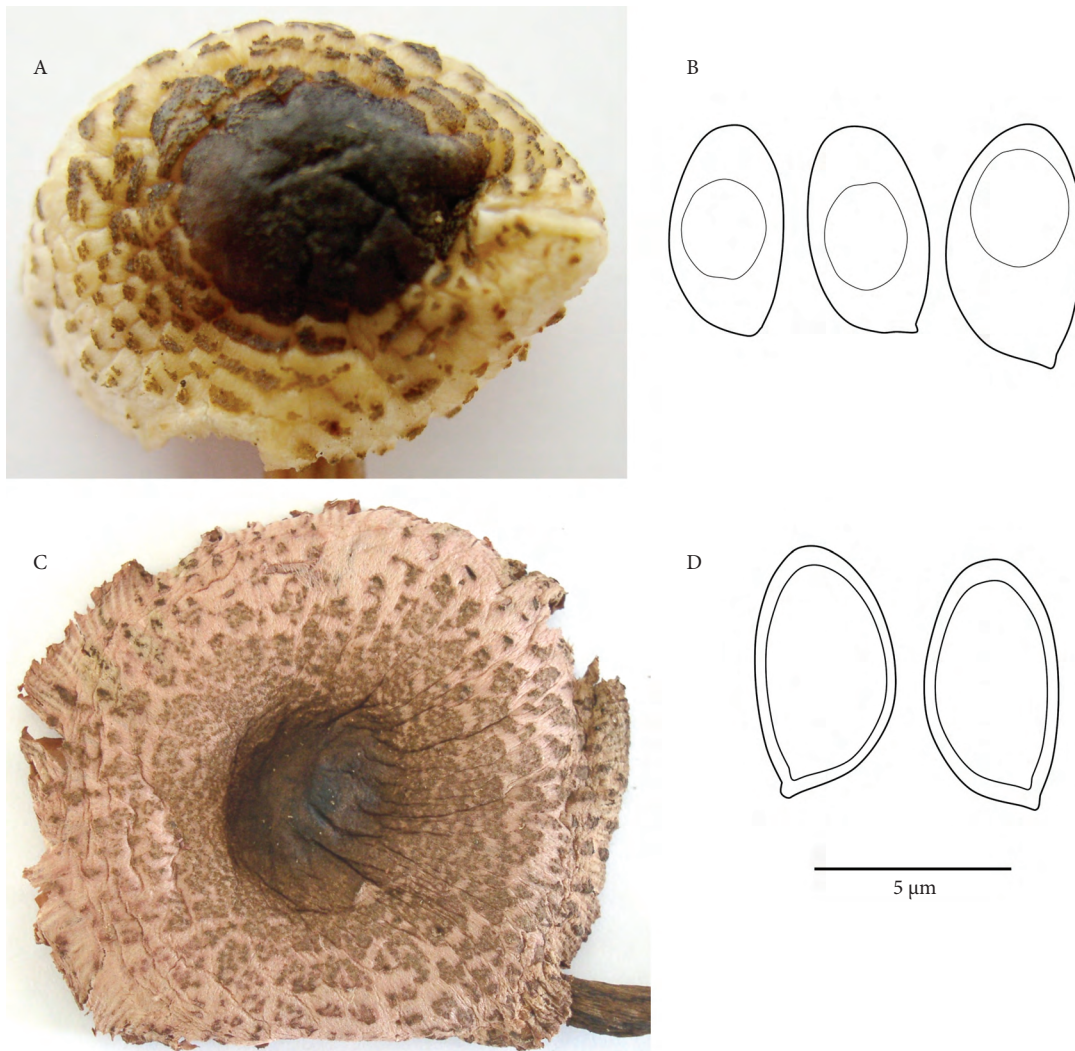


Figure 2. *Lepiota felina*: A- pileus surface, B- spores. *Leucocoprinus ianthinus*: C- pileus surface, D- spores.

***Macrolepiota konradii*** (Huijsman ex P.D.Orton)  
M.M.Moser, Kleine Kryptogamenflora, edn. 3  
(Stuttgart) 2b/2: 185 (1967).

Material examined: East Azarbaijan, Arasbaran  
forests, 2003/10/17, on soil (IRAN 11935).

***Macrolepiota procera*** (Scop.) Singer var. ***procera***,  
Pap. Mich. Acad. Sci. 32: 141 (1948).

Materials examined: Gilan, Asalem to Khalkhal,  
2003/09/30, on soil (IRAN 11902); Gilan, Asalem,  
1987/09/01, on soil (IRAN 9374); Gilan, Saravan Park,  
1994/09/18, on soil, (IRAN 9456); Gilan, Deilaman,  
2008/10/16, on soil (IRAN 13621); Gilan, Siahkal to  
Deilaman, 2008/10/13, on soil (IRAN 13582).

## Discussion

Despite their biological importance, knowledge about  
the occurrence and distribution of agaric fungi in  
southern Caucasia (Transcaucasia region) is scarce.  
In this study, 14 species of agarics, all belonging  
to lepiotaceous fungi, were determined from the  
Iranian part of Caucasia. Of the species identified, 6  
belonged to the genus *Lepiota*, 2 to *Leucocoprinus*, 2  
to *Chlorophyllum*, 2 to *Macrolepiota*, 1 to *Cystolepiota*,  
and 1 to *Leucoagaricus*.

From the determined species, 5 were new for  
Iranian mycobiota: *Chlorophyllum molybdites*,  
*Cystolepiota seminuda*, *Lepiota clypeolarioides*,

*Lepiota felina*, and *Leucocoprinus ianthinus*. Other species had already been reported from Gilan and Mazandaran provinces in the north of Iran. Due to the proximity of the Arasbaran Corridor to central Caucasia, the mycobiota of this region is more unique when compared to that of the Gilan Corridor, which is from Hyrcanian forests. Two of the identified species, *Lepiota cristata* and *L. clypeolarioides*, are poisonous mushrooms and can be dangerous for native peoples if consumed.

Some of the species recorded here have been reported from other regions in south and south-

western Caucasia such as Turkey, Azerbaijan, and Armenia. There are reports of *Chlorophyllum molybdites*, *C. rhacodes*, *Lepiota aspera*, *L. castanea*, *L. cristata*, *L. eriophora*, *L. felina*, *Leucoagaricus leucothites*, *Macrolepiota konradii*, and *M. procera* from north-eastern Turkey, located in south and south-western Caucasia (Demirel, 1999; Huseyinov et al., 2001; Afyon et al., 2004; Demirel et al., 2004, 2010; Sesli & Denchev, 2008). *L. felina*, *L. castanea*, *L. cristata*, *L. eriophora*, *Macrolepiota konradii*, and *M. procera* have also been reported from Azerbaijan and Armenia (Melik-Khachatryan et al., 1985).

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