Addition to the knowledge of the genus *Agaricus* in Iran

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Abstract

Five taxa *viz*, *Agaricus altipes*, *A. cupreobrunneus*, *A. placomyces*, *A. porphyrocephalus*, and *A. urinascens* var. *urinascens* are reported as new records for Iran. Details of taxonomical important features are also presented herewith. New localities in the west and north-west of the country are reported as habitats of *Agaricus* species in Iran.

Keywords: *Agaricaceae*, *Agaricales*, new localities, taxonomy

یافته‌های جدیدی از جنس *Agaricus* در ایران

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خلاصه

در این تحقیق، پنج آرایه از جنس *Agaricus* به اسامی *Agaricus altipes*، *A. cupreobrunneus*، *A. placomyces*، *A. porphyrocephalus* و *A. urinascens* var. *urinascens* برای نخستین بار از ایران گزارش می‌شوند. مشخصات میکروسکوپی و ماکروسکوپی مهم آرایه‌های گزارش شده ارایه شده است. همچنین، رویشگاه‌های جدیدی برای برخی گونه‌های جنس *Agaricus* در غرب و شمال‌غرب کشور معرفی می‌شوند.

واژه‌های کلیدی: آگاریکاسه، آگاریکالز، تاکسونومی، رویشگاه‌های جدید

Introduction

A list of Iranian *Agaricus* species was presented by Mohammadi Goltapeh *et al*. (2004). Seven other species *viz*, *A. comtulus* Fr., *A. osecanus* Pilát, *A. semotus* Fr., *A. pseudopratensis* (Bohus) Bohus, *A. subperonatus* (J.E. Lange) Singer, *A. xanthodermus*, and *A. xantholepis* (F.H. Møller) F.H. Møller were also reported from Iran (Saber & Esmaeili Taheri 2004, Saber & Zangeneh 2004).

Materials and Methods

Fungal specimens used in this study, originated from field samples collected from various habitats of Iran as well as specimens of the fungus collection of the Iranian Ministry of Jihad-e Agriculture ("IRAN"), Tehran, Iran. Specimens were studied in distilled water, cotton blue, and Melzer's reagent and 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. Spore range was obtained by measuring about 30–40 spores. Specimens identified using Cappelli (1984), Hansen & Knudsen (1992), Knudsen & Vesterholt (2008), Moser (1983) and Wasser (1989). All of the collected samples were kept in the Fungus Collection of the Iranian Ministry of Jihad-e Agriculture ("IRAN"), located at the Iranian Research Institute of Plant Protection, Tehran, Iran.

Results

Identification of collected samples of the genus *Agaricus* showed that, five species are new for Iran mycobiota. Details of studied materials along with short description and discussion of new records are as follows:

Agaricus altipes (F.H. Møller) F.H. Møller, Sb. nár. Mus. Praze 7B(1): 12 (1951)

Pileus 30–75 mm broad, convex to broadly plane, white, to slightly buff towards center, smooth to slightly silky fibrillose. Lamellae free, crowded, pink, becoming brown at maturity. Stipe 65–100 × 10–15 mm, equal to slightly swollen at the base, white, annulus hanging, thin and fragile, sometimes with scales on the underside. Spores 6.5–8 × 4.5–5.5 µm, ellipsoid, with germ-pore, Basidia 4-spored, 20–45 × 10–12 µm, broadly clavate to clavate. Cheilocystidia absent. Spore print chocolate brown.

Specimens examined: W Azarbaijan province, Khoy, Avrin, on soil, 03.07.2012, Asef, Amini Rad & Torabi (IRAN 16091 F); Takab, Belgheis Kuh, on soil, 05.07.2012, Asef, Amini Rad & Torabi (IRAN 16090 F).

Having hanging annulus, unchanging stipe base to red or yellow when bruising, spores with germ-pore and stipe longer than pileus diameter are the main characteristics of species. *Agaricus altipes* is current name for known species of *Agaricus*, *A. aestivalis* (F.H. Møller) Pilát. There is no consensus among authors on the taxonomic position of *A. aestivalis*. Heinemann (1978) and Bon (1985) placed this species in Rubescent group (subsection *Agaricus*) while Cappelli (1984), Wasser (1989) and Bohus (1990) included it in Flavescent group.

Agaricus cupreobrunneus (Jul. Schäff. & Steer) Pilát, Sb. nár. Mus. Praze 7B(1): 14 (1951)

Pileus 30–80 mm broad, convex to broadly convex, expanding to slightly plane at maturity, color brown with brown to purplish brown fibers and scales, surface of pileus dry, flesh thin, soft, pallid, discoloring slowly to pale dull-brown when injured, not yellowing in KOH, odor and taste mild. Lamellae free, close, young lamellae pink, becoming brown and then chocolate brown at maturity. Stipe 30–45 × 7–15 mm, tapering towards base to slightly bulbous at the base, pallid to brownish, annulus thin, fragile, slightly yellowish and evanescent. Spores 7–10 × 4.5–5.5 µm, elliptical, smooth, with germ-pore. Basidia 4-spored, 15–35 × 8–12 µm, clavate to broadly clavate. Cheilocystidia absent. Spore print blackish-brown.

Specimens examined: Mazandaran province, Amol, on soil, 13.04.2005, Zangeneh & Sadeghi (IRAN 16224 F); Flourd to Sangdeh, on soil, 10.10.2010, Asef & Torabi (IRAN 16226 F); Chamestan, Vaz, on soil, 13.10.2010, Asef & Torabi (IRAN 16225 F).

Agaricus cupreobrunneus is characterized by brown squamulose pileus, evanescent hanging and yellowish annulus and spores with germ-pore. Considering morphological characteristics,

A. cupreobrunneus is a close species to *A. porphyrocephalus,* but spores in *A. porphyrocephalus* are smaller (4.5–7 × 3–4.5 µm) than those of *A. cupreobrunneus.*

Agaricus placomyces Peck, Ann. Rep. N.Y. St. Mus. nat. Hist. 29: 40 (1878) [1876]

Pileus 50–100 mm broad, convex to broadly flat, slightly plane with age, surface dry, whitish color, densely covered with brownish fibers and scales especially towards the center. Cap yellow with KOH. Lamellae free, crowded, pink, eventually becoming brown. Stipe 60–100 × 10–12 mm, more or less equal or with bulbous base, fairly smooth, white, bruising yellow, especially at the base, with a persistent membranous annulus, initially covered in conspicuous flakes below the ring. Flesh white discoloring bright yellow in the base. Taste and odor usually not distinctive or somewhat unpleasant. Spores 4–7 × 3.5–5 µm; broadly elliptical; smooth. Basidia 4-spored, 20–35 × 8–12 µm, clavate. Spore print brown.

Specimen examined: Mazandaran province, Ruyan to Baladeh, Naghiabad, on soil, 09.10.2009, Asef & Torabi (IRAN 14419 F).

Agaricus placomyces is a member of *Agaricus* section *Xanthodermatei* and characterized by yellowing base when bruising. This species is recognized from *A. xanthodermus* by having squamulose pileus versus smooth (or sometimes slightly fibrous) pileus in *A. xanthodermus*.

Agaricus porphyrocephalus F.H. Møller, Friesia 4(3): 204 (1952)

Pileus 30–100 mm broad, convex to broadly convex to plane, brownish with brown to purplish brown fibers and scales, surface dry, margin of pileus with partial veil remnants, not yellowing in KOH. Lamellae free, close or crowded, pink becoming brown and then dark chocolate brown in maturity. Stipe 30–75 × 10–20 mm, more or less equal or tapering slightly to the base or sometimes slightly bulbous, whitish to brownish smooth or finely hairy, annulate with a thin and white annulus. Flesh whitish, without color change when bruising. Odor and taste not distinctive to pleasant. Spores 5–7.5 × 3–4.5 µm, elliptical. Basidia 4-spored, 20–40 × 7–12 µm, broadly clavate to clavate. Cheilocystidia absent. Spore print dark chocolate brown.

Specimens examined: Mazandaran province, Amol, Siahbisheh, Zardman, on soil, 19.07.2007, Asef, Amini-Rad & Sadeghi (IRAN 8525 F); Amol to Babol, Baliran, on soil, 15.07.2007, Asef, Amini-Rad & Sadeghi (IRAN 8523 F); E Azarbaijan province, Arasbaran, Ainalou, on soil, 08.11.2006, Asef & Torabi (IRAN 5294 F); Arasbaran, Kalaleh, on soil, 07.11.2006, Asef & Torabi (IRAN 5297 F).

Main morphological characteristics of *A. porphyrocephalus* are, brown squamulose pileus and hanging annulus.

Agaricus urinascens var**. *urinascens*** (Jul. Schäff. & F.H. Møller) Singer, Lilloa 22: 431 (1951) [1949]

Pileus 30–60 mm broad, convex, whitish covered with large ochraceous scales or patches, margin becoming toothed with age. Stipe 30–80 × 15–35 mm, slightly tapering or bulbous to the base, whitish cream, fibrillose, annulus thick, squamose below the annulus. Lamellae free, close, whitish-gray at first, then pale pinkish gray finally dark brown. Flesh whitish, sometimes reddening in the stipe on cutting or bruising. Spores 10–12 × 5.5–7.5 µm, ellipsoid. Basidia 4-spored, 20–40 × 10–15 µm, clavate to broadly clavate. Cheilocystidia numerous, long ovate, 10–30 × 5–15 µm. Spore print brown.

Specimen examined: Kordestan province, Saral station, on soil, 10.05.2006, Asef & Zare (IRAN 3126 F).

A. urinascens var. *urinascens* has the largest spores in the genus *Agaricus*. Large size of spores and squamose stipe below the ring are the main characteristics of the taxa.

***Agaricus* specimens collected from new localities in West and North-West of Iran:**

Agaricus augustus Fr.

Specimens examined: Kordestan province, Sanandaj to Divandarreh, on soil, 26.05.2005, Abdollahzadeh (IRAN 5274 F); Saral station, on soil, 10.05.2006, Asef (IRAN 3108 F); E Azarbaijan province, Arasbaran, 24.06.2004, Asef (IRAN 3090 F); Sahand, on soil, 19.08.2004, Asef, Pahlevani & Amini-Rad (IRAN 12433 F).

Agaricus campestris Schwein.

Specimens examined: E Azarbaijan province, Arasbaran, Kaleibar, Ghale Babak, on soil, 07.06.2007, Asef (IRAN 6900 F); Marand, Miab, Gharachi, on soil, 17.05.2012, Unknown (IRAN 16027 F).

Agaricus nivescens (F.H. Møller) F.H. Møller

Specimens examined: E Azarbaijan province, Makidi, 26.06.2004, Asef (IRAN 3112 F); Arasbaran, Kalaleh to Abbasabad, 10.05.2004, Asef (IRAN 3113 F).

Agaricus silvicola (Vittad.) Peck

Specimens examined: E Azarbaijan province, Arasbaran, on soil, 01.09.2004, Tavanaei (IRAN 3125 F); Kordestan province, Sanandaj, on soil, 15.05.2006, Asef (IRAN 5262 F).

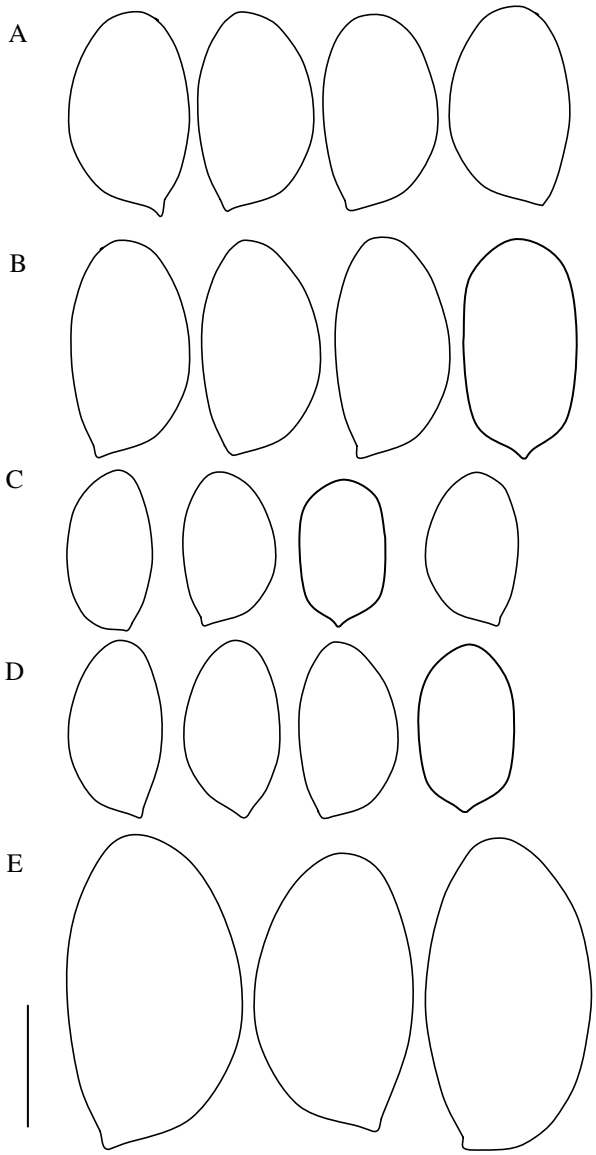

Fig. 1. Spores of *Agaricus* species A. *Agaricus altipes*, B. *A. cupreobrunneus*, C. *A. placomyces*, D. *A. porphyrocephalus*, E. *A. urinascens* var. *urinascens* (Bar = 5 µm).

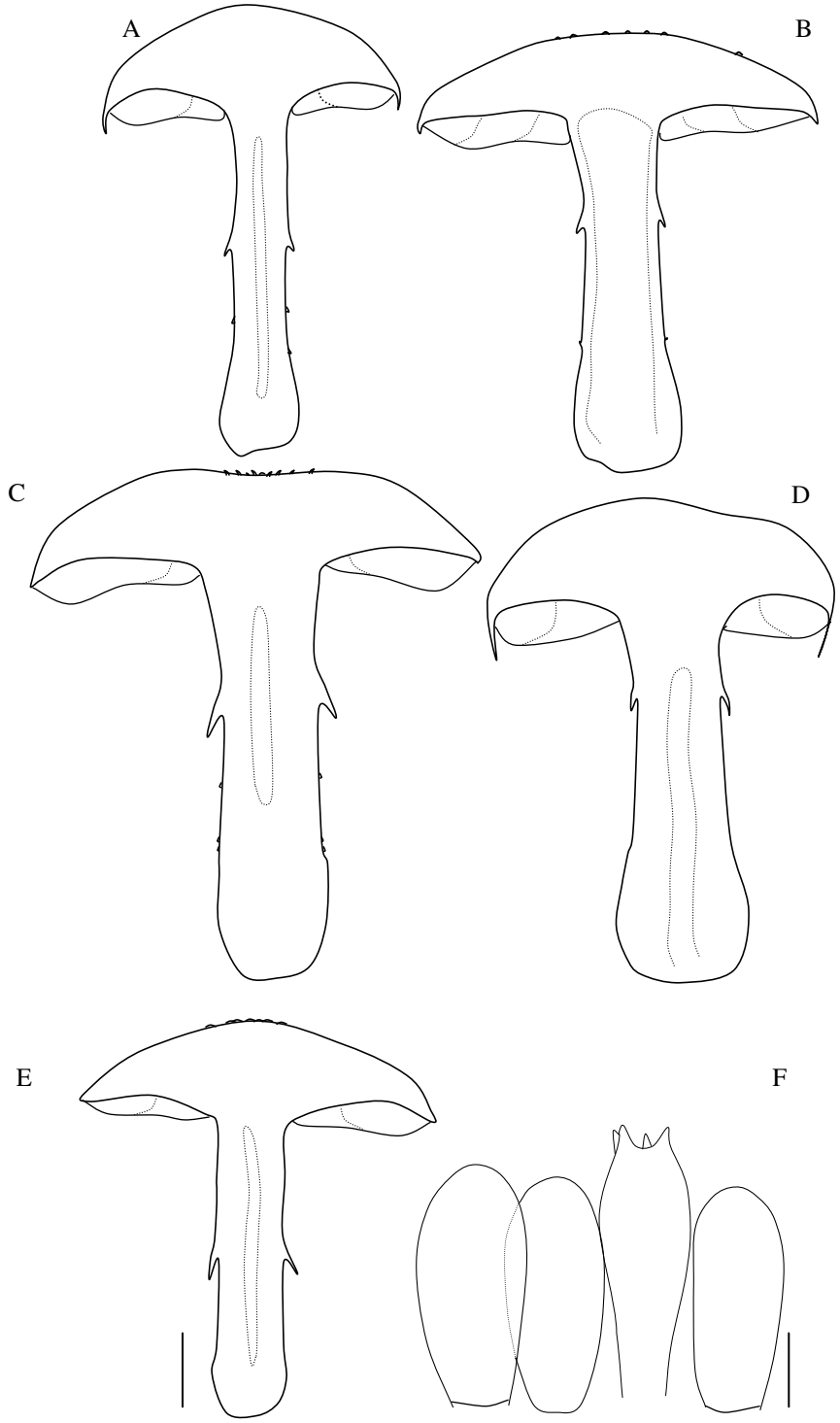

Fig. 2. Longitudinal cross section of pileus of *Agaricus* species: A. *Agaricus altipes*, B. *A. cupreobrunneus*, C. *A. placomyces*, D. *A. porphyrocephalus*, E. *A. urinascens* var. *urinascens* (Bar = 20 mm) F. Basidium and cheilocystidia of *A. urinascens* var. *urinascens* (Bar = 10 µm).

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