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Diversity of Agaricales from Kolhapur District, Maharashtra, India-I

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ABSTRACT

Order Agaricales is dominated by gilled mushrooms and is the most diverse group distributed worldwide. Many gilled mushrooms are best known for their nutraceutical and pharmaceutical importance. Kolhapur is one of the most developed districts of Maharashtra and is southernmost tip of the state. With an area of 8,074 km2, the district has Sahyadri mountain ranges on the western side, while the remaining region is a part of Deccan Plateau and rain shadow zone on the east. As a part of Western Ghats, the district has an ample floristic and fungal diversity. In the present work, 13 species of Agaricales, viz., *Agaricus xanthoderma*, *Chlorophyllum molybdites*, *Clarkeinda trachodes*, *Coprinellus disseminatus*, *Cystoagaricus trisulphuratus*, *Hygrocybe astatogala*, *Hypholoma subviride*, *Leucoagaricus americanus*, *Leucoagaricus rubrotinctus*, *Leucocoprinus birnbaumii*, *Marasmius pellucidus*, *Pleurotus djamor*, and *Termitomyces clypeatus* have been described, of which *Clarkeinda trachodes*, *Hypholoma subviride*, and *Marasmius pellucidus* have been reported for the first time from Maharashtra state.

Keywords: Diversity, Agaricales, Mushrooms, Maharashtra, Western Ghats, Taxonomy

INTRODUCTION

The Agaricales or euagarics clade (Basidiomycota, Agaricomycetidae) is the largest clade of mushroom-forming fungi and includes more than half of all known species of the homobasidiomycetes (Kherlenchimeg, 2014). The members of Agaricales grow abundantly in India especially during monsoon (July-September) and to a lesser extent during winter rains (November-February). Mushrooms have attracted attention since long time, chiefly due to their edibility. The fruiting bodies are above the ground or on wood and therefore they get prompt attention from the naturalists and amateur mycologists (Subramanian, 1973). Mushrooms are macro-fungi, that form macroscopic fruiting bodies, have many thousands of species that are unique and each species beautiful. Their enumeration, taxonomy, distribution, biology, chemistry, cultivation, and conservation, naturally are of great relevance and will generate perpetual interest and fascination to human kind (Subramanian, 1995).

The order Agaricales is by far the most extensively studied order amongst the Agaricomycetes. Ainsworth (1971) recognized 220 genera with 3250 species in Agaricales while Singer (1986) in "The Agaricales in Modern Taxonomy" classified it into three sub-orders (Agaricineae, Boletineae and Russulineae), containing 17 families comprising of 230 genera with over 7000 species worldwide. Hawksworth *et al.* (1995) in the "Dictionary of Fungi" accepted all the 17 families recognized by Singer (1986) except Boletaceae, Bondarzewiaceae, Cortinariaceae, Russulaceae, and Polyporaceae, which were raised to the rank of order as Boletales, Bondarzewiales, Cortinariales, Russulales, and Polyporales respectively. Kirk *et al.* (2008) mentioned 33 families containing 413 genera and 13,233 species in this order. Of the 33 families, Agaricaceae, Amanitaceae, Bolbitiaceae, Clavariaceae, Cortinariaceae, Entolomataceae, Hydnangiaceae, Hygrophoraceae, Inocybaceae, Lyophyllacae, Mycenaceae, Psathyrellaceae, Russulaceae, and Strophariaceae are the dominant representatives of fleshy macromycetes.

The first list on Indian Fungi was published by Butler and Bisby (1931) and revised by Vasudeva (1960). Additional revised lists have appeared in The Fungi of India (Bilgrami *et al.*,1979). Status of Indian Agaricales was reviewed first by Sathe and Rahalkar (1978) making 1825 as the base and then by Manjula (1983), providing an exhaustive list of Agaricoid and Boletoid fungi from India and Nepal. This list has been updated by Natarajan *et al.* (2005). The diversity of gilled mushrooms from Maharashtra state has been revised by Senthilarasu (2014).

MATERIALS AND METHODS

Study area

Kolhapur lies in the southwest between 15º43´ to 17º 10´ North Latitude and 73º 40´ to 74º 42´ East Longitude. Kolhapur district has tropical climate with high rainfall and warm summers. The monsoons rains are due to winds from the south-west as well as north-east. Rainfall is maximum (6000 mm) in the west to minimum (600 mm) in the east (District census Handbook Kolhapur, 1991). The district is rich in vegetation cover. The total forest coverage of district is 1672 km^2, out of which 563 $km^2$is reserve forest and 417 km^2 is protected forest. Total forest area is about 22% of the total geographic area of the district. There are three main types of forests- a) sub-tropical evergreen, b) moist deciduous and semi-evergreen and c) dry deciduous forest (The Gazetteers Department Kolhapur).

Collection and identification

All the species were collected during the monsoon seasons of 2020-2022 during several trips to various localities. Healthy specimens at different stages of development were collected. Field photographs were taken to note colour, size, shape, and habitat whereas, odour and other ecological characters were noted down in the field notebook. Microscopic observations of fresh fruiting bodies were done using 1.5% Phloxine B stain and Lawrence and Mayo N-300M research microscope. Dry and wet (70% ethanol) preservation techniques have been used for collected specimens.

Results and discussion

***Agaricus xanthoderma* Genev. *Bull. Soc. Bot. Fr.* 23: 28 (1876). Figure 1a**

Fruiting body 7 to 16 cm in hight. **Pileus** 5–10 cm in diameter; at first globose to hemispherical, convex and finally applanate or broadly umbonate in the centre; margin entire and thin; surface smooth, white when young, with age greyish or light brown or cream. **Lamellae** free, thin, crowded, with lamellulae, 6–9 mm broad, at first whitish pink to brown, finally dark brown to black. **Stipe** 7–14.5 ×1.2–2.2 cm, central, fistulose, cylindrical, erect, sometimes little twisted, equal or slightly bulbous, solid, smooth, glabrous, white, with an apical annulus. **Annulus** superous, two layered, membranous, up to 2 cm broad; infundibuliform, toward the edge enlarged, white. **Context** white at first turning yellow or chrome yellow. Odour phenolic. **Basidiospores** 5.2–6.8 × 3–4 µm, brownish, ellipsoid to ovate, rarely sub-globose, smooth. Spore-print dark brown. **Basidia** 18–26 × 6.7–7.9 µm, 4–spored, clavate or slightly truncate at the apex, hyaline, smooth. **Cheilocystidia** 22–30 × 12–18 µm; globose, pyriform, usually simple, hyaline, smooth.

Habitat

India, Maharashtra, Kolhapur, Shivaji University (16°40′39″N–74°15′17″E), on soil, solitary or scattered, 19.07.2022, Bornak, S. I. and Patil, Y.S. (Y22V6C1).

Remarks

Agaricus xanthoderma has been previously reported from Maharashtra (Sathe and Deshpande, 1982) and Punjab (Saini *et al.*, 2018). The species has been previously reported as *A. xanthodermus. A. xanthodermus* is an orthographic variant and its current name is *A. xanthoderma* (Myco Bank, 2022). The species is not suitable for human consumption as it contains toxic phenolic metabolites. (Gill and Richard, 1984). *A. xanthoderma* is a first report from the study area.

***Chlorophyllum molybdites* (G. Mey.) Massee, *Bull. Misc. Inf.*, Kew (no. 138): 136 (1898). Figure 1b**

Fruiting body 5 to 15 cm in height. **Pileus** 5–11 cm. in diameter; ovoid initially, hemispheric when expanding, plano-convex at maturity, with a low, broad and obtuse umbo; surface dry, longitudinally striate; initially white, becoming cream; covered with brownish squamules, that are uplifted or flat and concentrated near the centre. **Lamellae** free, sub-crowded to crowded, white, becoming greenish when mature, brownish when dried; lamellulae attenuate, unevenly distributed, in 4 ranks. **Stipe** 4–12 ×0.7–1.5 cm; white, cylindrical to beige, easily detachable from. **Pileus**, widening towards the base, base slightly enlarged, finely fibrillose. **Annulus** well – developed, membranous, upper surface whitish, lower surface brownish, double crowned. Odour and taste not distinctive. **Basidiospores** 9–11.6 ×6.3–8.3 µm, ellipsoid to elongate, thick-walled, smooth; olive-green, broad-truncate with wide germ pore, dextrinoid. Spore-print dull greyish green. **Basidia** 20–24 × 9–10 µm; clavate, hyaline, 4-spored. **Pleurocystidia** absent. **Cheilocystidia** 18–38 × 14–20 µm; broadly clavate to sphaero-pedunculate, hyaline, thin-walled. Lamella trama irregular, made up of subcylindrical, hyaline hyphae, 8–13 µm in diameter.

Habitat

India, Maharashtra, Kolhapur, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture (16°41′16″N-74°15′36″E), on ground, alone, scattered, 13.07.2020, Bornak, S. I. (Y20V5C1).

Remarks

Chlorophyllum molybdites is assigned to sect. *Chlorophyllum*, which is characterized by olive to greenish-white Basidiospores with a truncate apex, broadly clavate to sphaero-pedunculate Cheilocystidia and a palisade-like pileipellis of hyphae with terminal elements clavate to sub-fusiform (Ge *et al.*, 2018). The species has been reported from Karnataka, Kerala, Tamil Nadu, and Uttar Pradesh (Senthilarasu and Kumaresan, 2016), Pune, Maharashtra (Sathe and Rahalkar, 1976; Sathe and Deshpande, 1980,1982), Kolhapur, Maharashtra (Patil and Thite, 1978); Amravati, Maharashtra (Hedawoo, 2010).

***Clarkeinda trachodes* (Berk.) Singer. *Lilloa* 22: 413, 1951. Figure 1c**

Fruiting body 6 to 14 cm in height, fleshy. **Pileus** 6–10 cm in diameter; hemispherical when young, becoming convex to applanate at maturity; pellicle brown to dark brown, surface covered with numerous, small, revolute and loosely floccose, brown squamules; **Context** up to 8 mm thick in the centre of the Pileus, white, turning reddish with exposure. **Lamellae** free from Stipe, white to dirty white when young, olive brown when mature, crowded with lamellulae, margin entire, concolorous. **Stipe** 6–13 × 2.5–4.5 cm, central, sub-cylindrical, solid; surface white at the apex, light brown towards the base, glabrous above the annulus, lower half densely covered with minute, brown, squamules. **Annulus** present on the upper part of the Stipe, up to 16 mm, thick and membranous and remaining up to maturity, detached when dry. **Basidia** 12–25.4 × 5.8–8.7 µm, clavate to subclavate, thin-walled, tetrasporic, bearing four short sterigmata. **Basidioles** narrowly clavate to clavate. **Basidiospores** 5.2–6.1 × 3.6–4 µm, ovoid, sometimes broadly ellipsoid to ellipsoid, thick–walled, prominent germ pore, olive brown to dark, dextrinoid. **Cheilocystidia** 22–32 × 10–15 µm, abundant, scattered, clavate to broadly clavate, obpyriform, hyaline, smooth. **Pleurocystidia** absent.

Habitat

India, Maharashtra, Kolhapur, Rajaram College Campus (16°41′10″N–74°15′18″E) on soil, alone, 12.08.2020, Bornak, S. I. (Y20V13C1); Kolhapur, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture campus (16°41′16″N–74°15′36″E), on soil, alone, 19.09.2020, Bornak, S. I. (Y20V14C2); Kolhapur, Kaurwadi (16°44′34″N–73°58′32″E) on humid soil in a pair, 04.08.22, Bornak, S. I. (Y22V5C5); Kolhapur, Kolhapur-Radhanagari road, (16°26′35″N-74°02′49″E) scattered, on soil, 09.09.2022, Bornak, S. I. and Patil, Y.S. (Y22V7C2).

Remarks

Clarkeinda trachodes is distinguished by a large basidiome, prominent chocolate or coffee brown pellicle on the Pileus disc surface, presence of an annulus, olive brown to umber brown spore deposit, slightly thick-walled spores with a truncate apex and a Context that changes from white to reddish brown when cut (Hosen and Ge, 2011). This species has been reported earlier from only six places around the globe Sri Lanka, India, Malaysia, Indonesia, China and Italy (Kumar and Kaviyarasan, 2011). In India, it has been reported by Leelavathy *et al*. (1981), Kolli Hills, Tamil Nadu (Kumar and Kaviyarasan, 2011), and Jabalpur, Madhya Pradesh (Verma *et al.*, 2016). This is a first report from Maharashtra.

***Coprinellus disseminatus* (Pers.) J.E. Lange, *Dansk bot. Ark.* 9 (no. 6): 93 (1938). Figure 1d**

Pileus 0.4–0.9 cm in diameter; at first ovoid, then conic to campanulate, membranous; whitish grey to cream grey, glabrous, smooth; margin regular, sulcate striate almost to the disc. **Lamellae** adnexed, moderately crowded, whitish, soon becoming dark brown, non-deliquescent, with lamellulae. **Stipe** 0.8–1.2 cm, slender, cylindric, equal, hollow, white, almost translucent, arising from white, mycelial threads. **Context** thin. **Basidiospores** 6.8–7.8 × 3.7–4.2 µm, ellipsoid, broadly ovate, with a thick wall, truncated by an apical germ–pore, dark brown, smooth. **Basidia** 22–27 × 6–9 µm, clavate with 4-sterigmata, hyaline. **Pleurocystidia** absent. Clamp connections absent.

Habitat

India, Maharashtra, Kolhapur, Ajara, Kasar Kandgaon, Ajara-Chandgad Road (16°04′08″N–74°12′38″E), on dead log, in deep forest, in cluster, 22.08.2022, Bornak, S. I. (Y22V8C4).

Remarks

Coprinellus disseminatus is a tiny, non–deliquescent, fragile, coprinoid mushroom growing gregariously on dead wood logs, rotting stumps, and buried, decaying woods and roots. Initially the Pileus is subglobose to globose or ovoid, then hemispherical or obtusely conical to convex, fruit bodies often form in very large groups and are initially very pale, cream to almost white, darkening when mature; Cheilocystidia are absent along most of the gill edges; pileocystidia are lageniform with cylindrical neck and rounded (Hussain *et al.*, 2018). It has been reported from Karnataka, Kerala, Punjab, Sikkim, Uttar Pradesh, Jammu and Kashmir, and West Bengal. Sathe and Rahalkar (1975) and Sathe and Deshpande (1982) reported this species from Pune, Maharashtra as *Coprinus disseminatus.* This is a nomenclatural correction as well as new report from the study area.

***Cystoagaricus trisulphuratus* (Berk.) Singer, *Mycologia* 39(1): 87 (1947). Figure 1e**

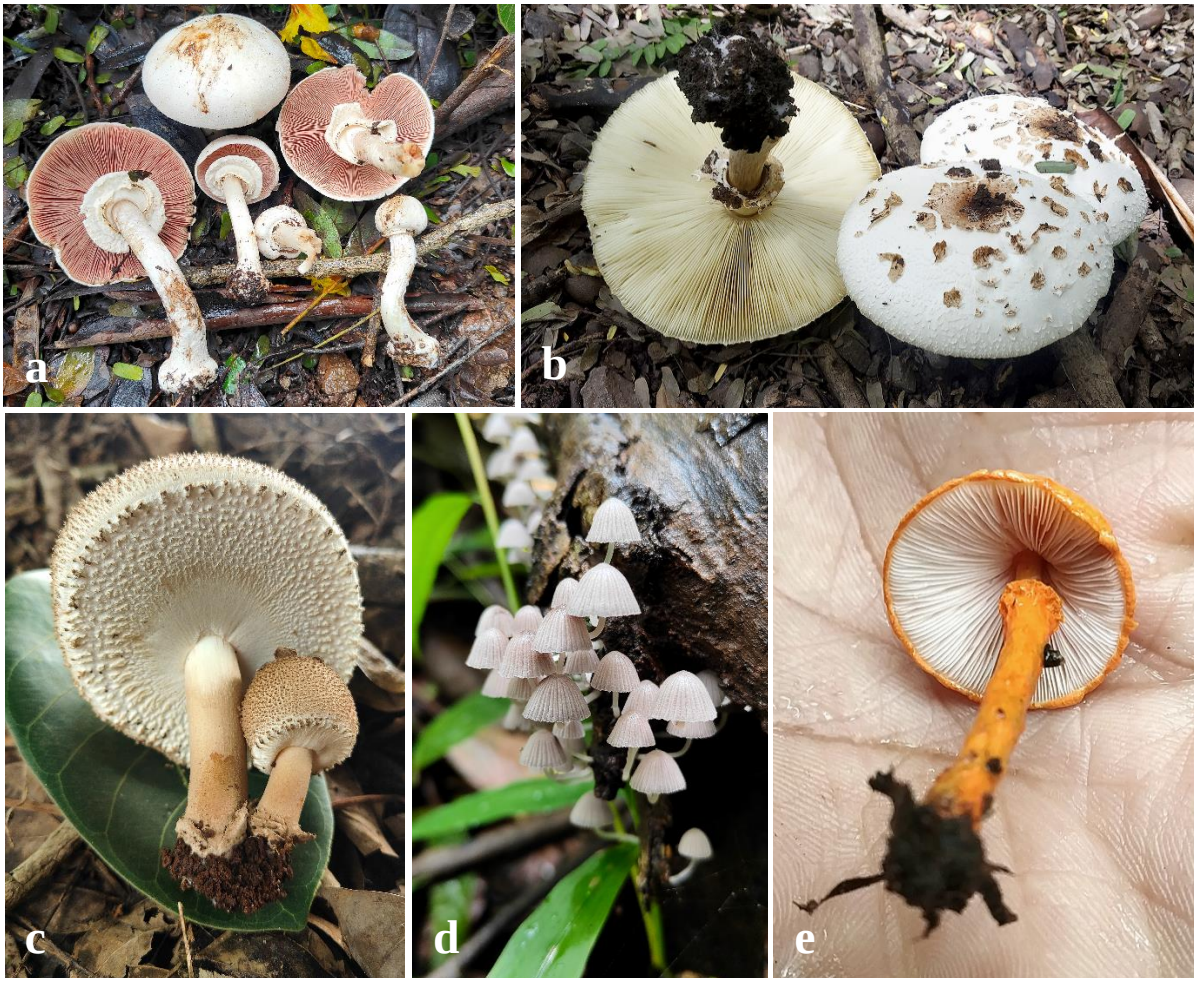

Figure 1: a, *Agaricus xanthoderma*, basidiomes in their natural habitat; **b,** *Chlorophyllum molybdites*, basidiomes in their natural habitat; **c,** *Clarkeinda trachodes*, basidiomes in their natural habitat; **d,** *Coprinellus disseminatus*, basidiomes in their natural habitat; **e,** *Cystoagaricus trisulphuratus*

Fruiting body 2 to 6 cm in height. **Pileus** 1.5–3 cm in diameter, convex; orange to reddish orange, covered by thick, small, floccose, appressed squamules, concolorous with the Pileus; margin involute to appendiculate, with velar remnants. **Lamellae** free, whitish to pale pinkish, becoming dark brown, crowded. **Stipe** 1.5–5 × 0.2–0.5 cm, equal, solid, cylindric, fistulose, concolorous with the Pileus below the annulus, lightly coloured above, covered by the pulverulent veil. Annulus superior, above the centre, floccose, fugacious. **Basidiospores** 4.5–6 × 3.2–4.1 µm, ellipsoid, adaxially applanate, thick–walled. Spore prints dark brown.

Habitat

India, Maharashtra, Kolhapur, Ajara, Hattiwade, Ajara - Mahagaon Road, (16°07′17″N–74°15′28″E), among leaf litter of bamboo plantation, alone, 08.07.2020, Bornak, S. I. (Y20V11C1).

Remarks

Cystoagaricus trisulphuratus (Psathyrellaceae Vilgalys, Moncalvo and Redhead), earlier reported as *Agaricus trisulphuratus* Berk. in Agaricaceae Chevall. is distinguished by small basidiomes having reddish orange Pileus and Stipe with well developed, concolorous, detersile universal veil on both the pileal and Stipe surfaces and indistinct, floccose annulus at the apex of the Stipe. Previously this species has been reported from Karnataka, Kerala, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal. From Maharashtra, it has been reported from Pune, Mulshi, and Ratnagiri (Senthilarasu and Kumaresan, 2016). This is a new report from the study area.

***Hygrocybe astatogala* (R. Heim) Heinem., *Bull. Jard. Bot. État Brux*. 33(2): 436 (1963). Figure 2a, b**

Fruiting body 8 to 12 cm in height. **Pileus** 4–5 cm in diameter; acutely conical, obtuse umbo then narrowly expand maintaining conical form; surface uniformly deep red to reddish orange, yellowish orange at extreme margin; covered by appressed, blackish fibrils, shiny, viscid when moist, pellucid striate; margin crisped, soon becoming black. **Lamellae** free to adnexed, initially white to pale yellow, soon becoming black, crowded with lamellulae of different lengths, finely eroded. **Stipe** 8–11 × 0.4–0.6 cm, cylindrical, little tapering towards apex; fistulose, surface whitish to yellowish white below, dull yellow above, smooth, becoming uniformly black on bruising or on injury. **Basidiospores** 7.4–9.6 × 5.5–7 µm, sub–globose, ellipsoid to broadly ellipsoid, hyaline, thin-walled with numerous guttules. **Basidia** 24– 41 × 7 –10 µm, clavate, 4-spored or 2-spored. **Cheilocystidia** 18–65 × 7–10 µm, fusiform, clavate, cylindrical, thin-walled, hyaline. **Pleurocystidia** absent.

Habitat

India, Maharashtra, Kolhapur, Padasali (16°42′26″N–73°50′35″E), amongst decaying litter, solitary, scattered, 24.06.2021, Bornak, S. I. and Patil, Y.S. (Y21V3C1).

Remarks

Hygrocybe astatogala shows close similarity with *H. conica*, which also turns black in age, however, *H. astatogala* differs in the presence of black fibrils on Pileus and Stipe from the beginning, in the shorter and broader sub-globose, ellipsoid spores, in the presence of true Cheilocystidia and in the excretion of fluid in moist conditions (Leelavathy *et al.*, 2006). Previous reports of this species are from Karnataka, Mangalore, Konaje Village (Greeshma, *et al.*, 2015); Kerala, Malappuram, Calicut University Campus (Leelavathy *et al.*, 2006); Wayanad, Begur, Kuruva; Trissur, Peechi (Mohanan, 2011). In Maharashtra it has been reported by Senthilarasu (2014) from Mahabaleshwar and Sindhudurg; Raigad; Thane; Ratnagiri (Borkar *et al.*, 2015) as *Hygrocybe conica*. This is a new report from the study area.

***Hypholoma subviride* (Berk. and M.A. Curtis) Dennis, *Kew Bull.* 15(1): 134 (1961) Figure 2c, d**

Fruiting body 1 to 4 cm in hight. **Pileus** 0.6–3 cm in diameter, conic, convex, expanding to plane, broadly umbonate; surface sulphur yellow darkening towards umbo, smooth, dry, glabrous; margin non–striate, brownish, decurved. **Lamellae** adnate, moderately close, sulphur-yellow when young, becoming vinaceous brown with age, with few lamellulae of two lengths. **Stipe** 0.5–3.5 × 0.1–0.3 mm, central, cylindrical, equal, hollow; surface concolorous with the Pileus, slender, smooth. **Basidiospores** 5.3–7.8 × 3–4.5 µm, elongated to ellipsoid, vinaceous brown, smooth, apically truncated by a broad germ-pore, with a thick wall. **Pleurocystidia** 17–36 × 5.2–9 µm; fusoid, mucronate. **Cheilocystidia** not observed. Clamp connections present.

Habitat

India, Maharashtra, Kolhapur, Pombare (16°43′02″N–73°55′53″E), on dead wood, in clusters, 20.06.2021, Bornak, S. I. and Patil, Y. S. (Y21V4C3).

Remarks

Currently *H. subviride* is recognized as *H. fasciculare* (Huds.) P. Kumm. (www.indexfungorum.org). However, according to Cortez and Silveira (2007), *H. fasciculare* morphologically differs from *H. subviride* in having larger Pileus up to 10–70 mm and Stipe 30–100 × 4–10 mm. Bessette, *et al.* (1997) also reported a large Pileus up to 20–80 mm and Stipe 50–120 mm × 3–10 mm; little developed veil on pileal surface and having a blackish, faint annular zone at the Stipe apex (Senthilarasu, 2016). The species has been reported from Kerala, Ernakulam, Perumbavoor, Iringole Kavu (Mohanan, 2011). Natarajan and Raman (1983) reported it from Tamil Nadu, Nilgiris, Lovedale, Naduvattum as *Naematoloma subviride* (Berk. and M.A. Curtis) A.H. Sm. Senthilarasu, (2016) recently reported it from Karnataka State, Kodagu district, Uppangala Forest. This is a first report from Maharashtra state.

Figure 2: a, b *Hygrocybe astatogala*, basidiomes in their natural habitat; **c, d** *Hypholoma subviride*, basidiomes in their natural habitat.

***Leucoagaricus americanus* (Peck) Vellinga, *Mycotaxon* 76: 433 (2000). Figure 3a**

Pileus 4–7 cm, cylindrical to sub-cylindrical, slightly convex sides, truncate apex, broadly conical, flattening to plano-convex to applanate, slight central depression; Pileus covered with fine granulose squamules in the centre, slightly larger in concentric or scattered patches around the centre that lessen towards the margin; disc remaining unbroken; disc and squamules brownish, slight pinkish to dark brown where handled, over white radially fibrillose background; margin sulcate. **Context** 3–4 mm thick, white to off-white. **Lamellae** free, unequal, close to crowded, ventricose to sub-ventricose, off-white to cream that discolours to brown with age. **Stipe** 5–10 × 1–1.8 cm, cylindrical, widening downwards, often curved, with slightly bulbous foot, hollow, white to off-white, often with pinkish tones, discolouring to brown when handled. Annulus 3–8 mm wide, ascending, with cuff-like part, whitish above, dark purplish brown on sides and below. Spore print off-white. Edible. Odour indistinct to pleasant sweet. Taste indistinct to slightly [illegible] **Figure 3a**

Basidiospores 7.7–9 × 5.9–7 µm, broadly ellipsoid to ellipsoid, with small apical germ pore, hyaline, dextrinoid. **Basidia** 26.4–30 × 8.2–9.7 µm thin-walled, hyaline, 4 - spored. **Cheilocystidia** abundant, 40–86 × 6.8–12.8 µm, narrowly lageniform with apical extension with restricted and inflated portions, sometimes narrowly clavate, without or with rostrate apical extension. **Pleurocystidia** not observed.

Habitat

India, Maharashtra, Kolhapur, Karveer, Koparde, (16°42′05″N–74°06′12″E), among leaf litter, in cluster 07.11.2020, Bornak, S. I. (Y20V11C4).

Remarks

Leucoagaricus americanus is recognized by its large fruiting bodies with sub-bulbous Stipes which first turn yellow, then later orangish red, followed

by vinaceous red to purplish brown after cutting. Presence of free, crowded Lamellae, ellipsoid Basidiospores with small apical germ pore. *Leucoagaricus americanus* is reported from Idukki and Thiruvananthapuram, Kerala (Verma *et al.*, 2018) and Pune, Maharashtra (Sathe and Rahalkar, 1976; Sathe and Deshpande, 1982) but as *Lepiota americana* (Peck.) Sacc. This is a new report from the study area.

***Leucoagaricus rubrotinctus* (Peck) Singer, *Sydowia* 2(1–6): 36 (1948). Figure 3b, c**

Pileus 1.5–4 cm in diameter; ovoid then conical at young, flat to concave when mature; white, covered by small, red, radially arranged scales, dark reddish brown in the center; surface dry and rough; margin straight, entire. **Lamellae** white, free, thick, with lamellulae, not bruising or staining when handled. **Stipe** 4–10 × 0.2–0.4 cm, white, cylindrical, solid, smooth, central, fibrous; annulus central, ascending, equal; club–shaped base. Annulus on the upper stem, with slightly reddish-brown edge. Trama white and consistent. **Basidiospores** 5.1–9 × 3.2–5.4 µm, ellipsoid, smooth, thick–walled, hyaline; germ pore absent. Spore print white. **Basidia** 16–24.5 × 6.5–8 µm, hyaline, claviform and tetrasporic. Pleurocystides not observed. **Cheilocystidia** 18–32 × 6.8–9.2 µm, hyaline, subclavate, polymorphic, fusiform-langeriform, ventricose.

Habitat

India, Maharashtra, Kolhapur, Panhala, Pombare (16°43′01″N–73°55′56″E), on soil, amongst decaying litter, solitary 26.06.2022, Bornak, S. I. and Patil, Y.S. (Y22V5C6).

Remarks

Leucoagaricus rubrotinctus is recognized by reddish to brown to orange Pileus, remaining dark brown in the centre. In young specimens, Pileus shows uniform colour which, when maturing gives the impression of small radial scales on a pale background. Basidiospores with an inconspicuous to absent germ pore (Ferreira and Cortez, 2012). *Leucoagaricus rubrotinctus* shows similar morphology with *Lepiota rubrotinctoides* Murrill, but differs from *L. rubrotinctus* by smaller Basidiospores (7 ×3.5 µm), lack of pileal scales and larger basidiomata (Murrill, 1912). Another similar species is *Leucoagaricus glabridiscus* (Sundb.) Wuilb., but it is a smaller and fragile mushroom, with a double layer of interwoven hyphae forming the Pileus covering (Kumar and Manimohan, 2009a; Verma *et al.*, 2018). *Leucoagaricus rubrotinctus* is distributed in Mangalore, Karnataka; Idukki, Karulai, Kollam, Kozhikode, Kuthiran, Malappurum, Muthanga, Nilambur, Peechi, Thrissur, Wayanad in Kerala and Jabalpur, Madhya Pradesh (Verma *et al.*, 2018). Trivedi (1972) reported this species as *Lepiota rubrotincta* from Nagpur, Maharashtra. This is a new report from the study area.

Figure 3b, c

***Leucocoprinus birnbaumii* (Corda) Singer, *Sydowia* 15(1-6): 67 (1962). Figure 3d**

Pileus 2.5–5.5 cm across; sulphur yellow in colour, oval to egg-shaped when young, becoming broadly conical, broadly convex, or bell-shaped; with loosely scattered, floccose squamules; the margin lined or grooved nearly to the centre by maturity; bright to light yellow. **Lamellae** free from the stem; crowded; short-gills frequent; pale yellow to yellow. **Stipe** 3–8 cm long; 2–5 mm thick; cylindrical, hollow, more or less equal above a slightly swollen base; Volva absent, sulphur yellow in colour; dry; powdery; with a fragile yellow ring that sometimes disappears; Annulus membranous, collar-like, somewhat evanescent, concolorous to Stipe, attached to the upper part of the Stipe. **Basidiospores** 8–12 × 5–7 µm; ellipsoid, with a pore at one end; smooth; thick-walled; hyaline in KOH; dextrinoid. Spore print white. Basidioles inflated. **Cheilocystidia** 50 × 15 µm; ventricose; rostrate; thin-walled; smooth; hyaline in KOH. **Pleurocystidia** absent. Pileipellis a cutis of elements 6–10 µm wide; terminal cells cylindric with rounded apices.

Habitat

India, Maharashtra, Kolhapur, Shahuwadi, Chandoli dam, (16°57′32″N–73°50′43″E), on ground, in pair, 06.19.2020, Bornak, S. I. (Y20V4C1).

Remarks

Features characteristic to *L. birnbaumii* are hemispherical to parabolic Pileus, sulphur yellow colour, sulcate striate Pileus, covered by floccose squamules of the same colour, free Lamellae and elongated, yellow Stipe with bulbous base (Dutta *et al.*, 2011). The species has been previously reported from Maharashtra, Pune, Pune University Campus by Senthilarasu (2014). This is a first report from the study area.

Figure 3: a, *Leucoagaricus americanus*, basidiomes in their natural habitat; **b, c** *Leucoagaricus rubrotinctus*, basidiomes in their natural habitat; **d,** *Leucocoprinus birnbaumii*, basidiomes in their natural habitat.

Figure 4: a, b, *Pleurotus djamor*, basidiomes in their natural habitat; **c,** *Marasmius pellucidus*; **d, e** *Termitomyces clypeatus*, basidiomes in their natural habitat.

***Marasmius pellucidus* Berk. and Broome, *J. Linn. Soc., Bot.* 14: 35. 1873. Figure 4c**

Pileus 1.4–5.3 cm, obtusely conical to convex or campanulate when young, expanding to broadly convex, campanulate or nearly plane in age, often with a shallow central depression; margin striate to rugulose-striate, decurved to upturned, wavy or undulate; glabrous, moist to dry, dull; disc ivory, cream, pale orange white, or pale brownish grey; margin white, ivory, buff, pale yellowish white, on maturity pileal surface often dingy white and pellucid. **Lamellae** adnate to shallowly adnexed, close to sub-distant or distant, narrow, sometimes not reaching Pileus margin, intervenose, white to ivory, pale yellowish white to cream; edges even, non-marginate. **Stipe** 3.8–12 × 0.1–0.3 cm, central, terete, equal, sometimes wavy, tough, sometimes twisted fibrous, dull, dry, apex minutely pruinose, base pruinose to appressed–fibrillose; base brown to reddish brown. Odour mild. Taste not distinctive. **Basidiospores** 6.3–8.2 × 2.8–4.2 µm, sub-fusoid to ellipsoid or amygdaliform, with a prominent hilar appendix, smooth, hyaline, inamyloid. **Basidia** 14–28 × 4.2–6.9 µm, clavate, 4-spored. Basidioles clavate to sub-fusoid. **Cheilocystidia** 11–28 × 4.4–8.2 µm, abundant; lamellar edge sterile, versiform, ranging from irregularly cylindrical to fusoid, ventricose, hyaline, thin–walled. **Pleurocystidia** absent. Pileipellis a hymeniform layer cells 12–26 × 9–20 µm, sub–globose to pyriform, clavate or broadly clavate, sometimes in short chains, hyaline, thin walled. **Caulocystidia** 17–53 × 5–10.5 µm, versiform, irregularly cylindrical to fusoid, ventricose, clavate. Clamp connections present in all tissues.

Habitat

India, Maharashtra, Kolhapur, Shahuwadi, Amba Devrai (16°58′29″N–73°48′5″E), among leaf litter, in clusters, 19.06.2020, Patil, A. R. and Bornak, S. I. (Y20V4C22).

Remarks

M. pellucidus is recognized easily in the field due to its relatively large, paper-thin, white, pellucidstriate Pileus; very narrow and intervenose Lamellae and cespitose, reddish brown to brown Stipes. It forms large, dense clusters on leaf litter, woody debris or on rotten logs. Microscopic diagnostic features include, a hymeniform pileipellis of broadly clavate, non-setulose cells; versiform, non-setulose Cheilocystidia and caulocystidia; a lack of Pleurocystidia; small, sub-fusoid Basidiospores; and dextrinoid tissues (Wannathes *et al.*, 2004). Distribution of *M. pellucidus* in India is rare and scattered. The species has wide distribution in south Asia, Borneo, Java, Malaysia, New Caledonia, Singapore, Sri Lanka, and Thailand (Wannathes *et al.*, 2004). In India, the species has been reported from Kodagu, Karnataka by Karun and Sridhar (2016). This is a first report from Maharashtra.

***Pleurotus djamor* (Rumph. ex Fr.) Boedijn, Wit, H.C.D. de, Ed., Rumphius Memorial v.292. 1959. Figure 4a, b**

Pileus 4–7 × 1.5–3.5 cm, spathulate to flabelliform, pinkish when fresh, yellowish white upon aging, clear brown when dry. Surface smooth, glabrous, margin smooth. **Lamellae** decurrent, close to crowded, concolorous with the Stipe, sometimes whitish, smooth, margin entire. Lamellulae present. **Stipe** absent or reduced, 0.3– 0.7 × 0.2–0.4 cm, whitish when fresh, cream when dry, eccentric or lateral, surface irregular, sometimes smooth. **Basidiospores** 7.8–9 × 3.2–5 µm, cylindrical, oblong, thin–walled, hyaline, smooth, inamyloid. Spore print white or very light pink. **Basidia** 25–27 × 5.2–6.3 µm, club shaped or clavate, four–spored. Basidioles numerous. **Pleurocystidia** not observed. **Cheilocystidia** 21–28 × 6–7.5 µm, sub–ventricose to clavate.

Habitat

India, Maharashtra, Kolhapur, Panhala, Manwad (16°43′23″N–73°55′24″E) on decaying wood, 21.09.2021, Bornak, S. I. and Patil, Y. S. (Y21V5C2).

Remarks

P. djamor has many synonyms. The species differ mainly in Pileus colour, which ranges from deep pink, salmon to slightly pinkish and even white. Corner (1981) has recognized six varieties of *P. djamor* based on differences in Pileus and Lamellae colour, shape of Stipe and substrate. However, nomenclature of these varieties is highly confusing. *P. djamor* is an edible mushroom cultivated throughout India. In wild, the species is very scattered. The species has been reported from Karnataka (Karun and Sridhar, 2016); Kodagu district, IIT campus, Chennai (Roy *et al.*, 2017) and Tripura (Jegadeesh *et al.*, 2018) and Pune, Maharashtra (Senthilarasu, 2014). This is a first report from the study area.

***Termitomyces clypeatus* R. Heim, *Bull. Jard. Bot. État Brux*. 21: 207 (1951). Figure 4d, e**

Fruiting body medium to large. **Pileus** 4–7.5 cm diameter, conical at first becoming convex, with central, prominent, spiniform perforatorium; surface dark brown at the centre, elsewhere greyish brown to brown, dry, fibrillose, silky and viscid or slimy when wet, smooth, glabrous; margin decurved, entire, soon radially cracked. **Lamellae** free, broad, regular, white, creamy when young, crowded with lamellulae. **Stipe** 6.5–13.5 × 0.6–0.90 cm; surface white, central, cylindrical, smooth, solid, expanding below with swollen base, radiated, long tapering pseudorhiza downwards. Annulus absent. **Basidiospores** 6.2–7.2 × 4–4.5 µm, ellipsoid, smooth, hyaline, inamyloid, thin–walled.

Habitat

India, Maharashtra, Kolhapur, Panhala, Pombare (16°43′02″N–73°55′53″E), amongst decaying litter, solitary or scattered, 20.06.2021, Bornak, S. I. and Patil, Y. S. (Y21V4C2).

Remarks

T. clypeatus can be distinguished by medium to large sized basidiomes having brownish, smooth, Pileus with strongly spiniform to acutely pointed umbo, and smooth Stipe with long hypogeal white pseudorrhiza. Morphologically *T. clypeatus* resembles with *T. tylerianus*, but the former differs in a spiniform to acute umbo with a silky pileal surface. (Karun and Sridhar, 2013). *T. clypeatus* has been previously reported from Konkan region of Kunkeshwar, Maharashtra (Patil *et al.*, 1979). This is a first report from the study area.

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