New Species of Agaricales

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Clitocybe alboinfundibuliforme sp. nov. is widely distributed in Korea. *Volvariella koreana* sp. nov. is rarely distributed in Korea. These taxa were occasionally found together at the same place. Both of these species seem to be associated with each other. These two species are fully described and illustrated in this paper.

KEYWORDS : *Clitocybe alboinfundibuliforme*, New species, *Volvariella koreana*

During the investigation of macro-fungi on the Korean peninsula, species of Agaricales, *Volvariella* sp. and *Clitocybe* sp., were found to be appearing together, and seems to be associated with each other. Some species of *Asterophora lycoperdoide* (Bull.) Ditmar or *Asterophora parasitica* (Bull. ex Pers.) Singer (1986) find on the decaying basidiomes of *Russula nigricans* (Bull.) Fr.; *Lactarius vellereus* (Fr.) Fr. and allied species or *Syzygospora tumefaciens* (Ginns & Sunhede) Ginns find on *Gymnopus dryophilus* (Bull.) Murrill and *Hodocollybia butyracea* f. *butyracea* (Bull.) Lennox were reported. Not much is known about macro-symbionts among Agarics fungi, except symbiosis between *Gomphidius roseus* (Fr.) Fr. and *Suillus bovinus* (Pers.) Roussel. Symbiosis between *Volvariella* sp. and *Clitocybe* sp. has not been reported. In this paper, the principal diagnostic features of *Volvariella* sp. were described and illustrated according to Orton (1974) and Bigelow (1982), viz. the color of the pileus and volva, the morphology of the volva (especially *Volvariella*), the microscopic features of pileipellis, stipitipellis, spores, basidia, cystidia and their habitat. In the following descriptions, color names are given in quotations and color notations, e. g. 4A2~8F4, are from those of Kornrup and Wanscher (1978).

The collections cited here are all deposited in the herbarium of the Herbarium Conservation Center of National Academy of Agricultural Science (HCCN).

1. *Clitocybe alboinfundibuliforme* sp. nov. (Korean name: Bidanteolkkalddaegi beoseos)

Pileus 25~54 mm latus, infundibuliformis, fere cavus ad basis, siccus, glaber, albidus, demum ivory grayish-orange,

hygrophanus, ad marginem involutus, caro tenuissima, albida, odor nullus. Lamellae decurrentes, distante, albidae demum pallido brunneae. intervenosae. Stipes 28~48 mm longus, 3~6 mm crassus, equals, Crepido tumidae, ad pileus concolor, cavus. Sporae 4~6.3 × 3.2~4 µm, inamyloideae, in cumulo albae. Basidia 19.6~28.4 × 4.2~5.4 µm, tetrasporigera. Cystidia inconspicua. Pileipellis subgelatinosa, interspersus cum vespiculose elementus.

Holotypus. Mt. Sookji, Suwon-si Paldal-gu Hwaseodong, Gyeonggi-do, 3 September 1994 (HCCN 01619).

Pileus. 25~54 mm across, uniform, infundibuliform, trumpet-shaped, and generally hollow to the base of the stipe. The pileus is rarely convex and is depressed at the center, with the margin inrolled when young and remaining incurved for a long time. It is somewhat undulate, acute, with a dry, smooth surface. Hygrophanous, it is snow white in color, turning with age to yellowish-white (4A2) to ivory (4B3), orange-white (5A2) to grayish-orange (5B3) in part or towards the margin. In addition, it has a thin context, indistinct odor, and a mild taste.

Lamellae. With a long decurrent shape sometimes reaching to the stipe, and a distant, rarely strongly intervenose character, the lamellae are pure white when young, but change to a very pale brown (10YR7/3-4) to yellow (9-10YR7/6-8), or yellowish-white (4A2) to ivory (4B3), orange-white (5A2) to grayish-orange (5B3) when old, with smooth edges.

Stipe. 28~48 × 3~6 mm, hollow, cylindrical, tapering toward the base, but at times thickened just at the base. It has a dry, smooth surface, and is pure white in color, turn-

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ing yellowish-white (4A2) to ivory (4B3), orange-white (5A2) to grayish-orange (5B3), with age.

Microscopic features (Fig. 1). Spore print is white. Spores are $4\sim 6.3 \times 3.2\sim 4 \mu\text{m}$, elliptical, tip-shaped, smooth, hyaline, and inamyloid. Basidia are $19.6\sim 28.4 \times 4.2\sim 5.4 \mu\text{m}$, clavate, with 4-spores and basal clamp connections. Cheilocystidia and pleurocystidia were not seen. Pileipellis consists of irregularly parallel hyphae $2\sim 5 \mu\text{m}$ across, slightly gelatinized, generally interspersed with vesicular elements called physalids $28.5\sim 35.8 \times 16.4\sim 20.5 \mu\text{m}$, which are also found in the apex of the stipe; generally septa with a clamp connection.

Holotype. Mt. Sookji, Suwon-si Paldal-gu Hwaseo-dong, Gyeonggi-do, 3 September 1994 (HCCN 01619).

Habit and Habitat. Summer to fall, grouped or gregarious, rarely scattered on the rich humus soils or the piles of fallen leaves in hardwood or in mixed woods and sometimes co-associated with *Volvariella* sp. (Fig. 3A~C).

Specimens examined. Mt. Sookji, Suwon-si Paldal-gu Hwaseo-dong, Gyeonggi-do, 3 September 1994 (Holotype, HCCN 01619); Mt. Halla, Jeju-si, Jeju-do, 19 July 1997 (6477A); Mt. Yeogi, Suwon-si Paldal-gu Hwaseo-dong Gyeonggi-do, 8 August 1997 (6494A); Mt. Seolak, Buk-myeon, Inje-gun, Gangwon-do, 6 September 1997 (6583A); Mt. Chiack, Socho-myeon, Wonju-si, Gangwon-do, 16 July 1998 (7172A); Mt. Yeogi, Suwon-si Paldal-gu Hwaseo-

dong Gyeonggi-do, 16 July 1998 (7196A); Temp. Naewon, Habuk-myeon, Yangsan-si, Gyeongsangnam-do, 3 August 2000 (8392A); Mt. Yongin-si Cheoingu Mohyeon-myeon, Gyeonggi-do, 27 August 2000 (8525A); Dalter Park, Yangjae-dong, Seocho-gu, Seoul, 31 August 2000 (8548A); Mt. Chiack, Socho-myeon, Wonju-si, Gangwon-do, 11 October 2000 (8880A). Mt. Yeogi, Suwon-si Paldal-gu Hwaseo-dong Gyeonggi-do, 19 August 2002 (10620A).

Remarks. The specimens found at Gyeonggi-do, Gangwon-do, Gyeongsangnam-do and Jeju Island tend to be a common species and widely distributed in Korean peninsula. They are usually found having the gregarious or grouped habit of carphophores and sometimes co-associated with *Volvariella* sp.. This new taxon belongs to section Bulluliferae, subgenus Cystoclitus, and is similar to *Clitocybe phaeophthalma* (Pers.) Kuyper in having the pileipellis and stipitipellis consisting of the peculiar vesicular elements. The latter differs from the former in having a convex pileus with a depressed center, with a lardaceous, grey-beige pileal surface, and may be associated with *Volvariella* sp.. This species also differs from other similar white species of *Clitocybe* by having pileipellis composed of irregularly parallel hyphae, with scattered vesicular elements called physalids.

This taxon is well characterized by the entirely pure white carpophores, infundibuliform in shape and generally hollow to the base of the stipe, with long decurrent lamellae and also associated with *Volvariella* sp. (Fig. 3E~H).

2. *Volvariella koreana* sp. nov. (Korean name: Kkald-daegibidanteolbeoseos)

Pileus 25~45 mm latus, conicus vel conius-campanulatus, dein convexus vel planus, ad centrum umbonatus, superficies primum griseo-brunneus, demum rufulus-griseus, appressus fibrillosus, ad marginem appendiculatus, carnosus ad centrum, albida, odor inconspicuus. Lamellae liberae, confertae, albidae demum roseae incarnatae. ad aciem albidae fimbriatae, lamellulis intermixtae. Stipe 50~57 mm longus, ad apicem 2~2.7 mm crassus, aequalis vel sursum attenuatus, innatus fibrillosus, cavus. Volva membranacea, primum griseo-brunneus, demum pallidus ochracea. Sporae $4.8\sim 5.1 \times 3.2\sim 3.7 \mu\text{m}$, inamyloideae, in cumulo sordidus. Basidia $18.6\sim 26 \times 7.4\sim 8.4 \mu\text{m}$, tetrasporigera. Pleurocystidia $42\sim 53 \times 12\sim 23.3 \mu\text{m}$, fusoides ventricosa vel lageniforma, ad apicis subcapitatus. Cheilocystidia $35.3\sim 45.6 \times 9\sim 17 \mu\text{m}$, fusoides ventricosa vel sublageniforma, ad apicis subcapitatus vel aliquando flexuosus, tenuis, fasciatus. Hyphae non fibulatoriae.

Holotypus. Mt. Sookji, Suwon-si Paldal-gu Hwaseo-dong, Gyeonggi-do, 3 September 1994 (HCCN 01615).

Pileus. Basidiocarps small. Pileus are 25~45 mm wide,

Fig. 1. *Clitocybe alboinfundibuliforme*. a, spores ($\times 1000$), b, basidia ($\times 1000$), c, pileipellis ($\times 400$), d, stipitipellis ($\times 400$), e, cheilocystidia ($\times 1000$).

at first conical to conico-campanulate, then plano-convex to plane, usually papillar to broadly umbonate at center. It is never depressed in the center. The surface varies in shades from grayish-white to whitish, sometimes orange-gray (6B2) to flesh (6B3) or grayish brown (7-8C-D3-4), grayish-brown (7-8E3) to dark brown (7-8F3-4) at center when young, and then reddish-grey (8B2) to a dull red, paler towards the margin, often darker to pale grayish-buff in center, with a radially grayish, appressed fibrillose or densely felted hairy surface, the margin sometimes appendiculate and projecting beyond the lamellae.

Context are White, fleshy, thick at center, thin towards the margin, odor slightly similar to *Pleurotus ostreatus* (Jacq.) P. Kumm. (fungoid) with a mild.

Lamellae are free, subcrowded to crowded, white, later sordid incarnate, with a thin, white edge; fimbriate to flocculose. Lamellulae are 1-or 2-tiered.

Stipe are $50\text{--}57 \times 2\text{--}2.7$ mm (at apex), cylindrical, somewhat equal or attenuated upwards, but slightly thickened at the base. When young, it is whitish in color, discoloring to a pale fawn later in life. At the apex, it is finely pruinose, entirely innately fibrillose striate, but silky-pubescent near the base. Volva is membranous, rather thick, white and then later becoming very pale cream to pale ochraceous buff, with a two or three-lobed margin and felted outer surface.

Microscopic features (Fig. 2). Spore print is sordid. Spores are $4.8\text{--}5.1 \times 3.2\text{--}3.7$ μm , smooth, ellipsoid to ovoid, and slightly thick-walled. Basidia are $18.6\text{--}26 \times 7.4\text{--}8.4$ μm , normal, and four-spored. Pleurocystidia are $42\text{--}53 \times 12\text{--}23.3$ μm , fusoid-ventricose to lageniform, thin-walled with subcapitate to a broadly obtuse apex. Cheilocystidia are $35.3\text{--}45.6 \times 9\text{--}17$ μm , sublageniform, subcapitate or fusiform-ventricose with a long neck, sometimes flexuous, thin-walled, and bundled. Pileipellis of pileus is cylindrical to filamentous, $56\text{--}123 \times 11.3\text{--}18$ μm , and thin-walled without a clamp-connection.

Holotype. Mt. Sookji, Suwon-si Paldal-gu Hwaseo-dong, Gyeonggi-do 3, September 1994 (HCCN 01615).

Habit and Habitat. Solitary to scattered, near or among the fruit-bodies of *C. alboinfundibuliforme* on the rich humus soils, or well decayed fallen leaves in hardwood or in mixed woods (Fig. 3D).

Specimens examined. Mt. Sookji, Suwon-si Paldal-gu Hwaseo-dong, Gyeonggi-do, 3 September 1994 (Holotype, HCCN 01615); Park Dalter, Yangjae-dong, Seocho-gu, Seoul, 31 August 2000 (8549A); Mt. Yeogi, Suwon-si Gwonseon-gu Seodun-dong, Gyeonggi-do, 19 August 2002 (10621A).

Remarks. The first specimen of this taxon was found

Fig. 2. *Volvariella koreana*. a, spores ($\times 1000$), b, basidia ($\times 1000$), c, cheilocystidia ($\times 1000$), d, pleurocystidia ($\times 1000$), e, pileipellis ($\times 400$), f, hairs at the base of stipe ($\times 400$), g, marginal cells of volva ($\times 400$).

among the *Clitocybe* sp. on the rich humus soils under the mixed forests of *Quercus* sp., *Acacia* sp. and *Pinus rigitaeda*, Mt. Sookji in Suwon, 11 August 1994. More specimens were added from Mt. Seonun, and Park Dalter, Seoul. This taxon is well characterized by its specialized habitat among or near *Clitocybe* sp., the whitish or greyish brown to dark brown pileus, usually papillar to broadly umbonate at center and smaller spores. They coincide well with some species belonging to stirp Taylori according to Orton (1986). This species can also be confused with other small species of *Volvariella*, such as *Volvariella murinella* (Qué.) M.M. Moser, *Volvariella caesiostincta* P.D. Orton, *Volvariella taylorii* (Berk. & Broome) Singer, and *Volvariella surrecta* (Knapp) Singer. But *Volvariella murinella* (Qué.) M.M. Moser differ from the present species by the white-grey or light beige pileus without a distinct papillar to umbonate at center, are narrow, have elongated to subcylindrical spores and a different ecology. *V. caesiostincta* is characterized having cheilocystidia with conspicuous rostrum, like to forked apical projection, and grows on rotten wood. Also, *V. taylorii* differs

Fig. 3. Carphophores of *C. alboinfundibuliforme* and *V. koreana*. A~C, *C. alboinfundibuliforme* (HCCN 01619); D, *V. koreana* (HCCN 01615); E~H, carphophores of these two fungi growing together.

from this taxon by having slightly larger basidiocarps with a brown to ochraceous grey volva and a pale buff grey to grey pileus, without a prominent papilar to umbonate at

center. And the basidiocarps of *V. surrecta* are typically found growing on the dead fruit-bodies of *C. nebularius*, characterized by the smooth stipe surface.

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