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Taxonomic Studies on the Genus *Lactarius* of Korea(I)

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韓國産 무당버섯科의 分類學的 硏究(第1報)

*Lactarius*屬의 分類

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Abstract: Mushrooms were collected at Mt. Gyeryong, Mt. Chilgab, Mt. Ducyu, Mt. Chiri, Mt Songri and the regions of Chungnam Province for 15 months from July, 1983 to October, 1984. They were classified into 19 species, four varieties and one form of *Lactarius*. These species were grouped into six sections according to Hesler and Smith. Of these *Lactarii*, nine species and four varieties appeared to be newly found ones.

Keywords: *Lactarius*, *Plinthogalus*, *Lactifluus*, *Triste*, *Piperites*, *Russularia*, Classification of Basidiomycetes.

The family *Russulaceae* is composed of two genera, *Russula* and *Lactarius*. The heteromerous trama without clamp connections in the pileus, and the amyloid spores with distinct ornamentation are sufficient to distinguish this family from all others. In two genera, on the other hand, *Lactarii* have latex, but *Russulas* not, so that they are easily distinguished.

Lactarii are used for food in many countries. *L. volemus* and *L. deliciosus* are very palatable and often eaten in Europe and Asia. The species that seem to be poisonous in *Lactarius* are *L. helvus* and *L. pallidus*, which are not found in Korea.

The majority of the *Lactarii* occuring in the temperate zones are considered as obligatory mycorrhizal fungi which form ectotrophic mycorrhiza with forest trees of conifers and broad-leaved families. It was found that most of these species lived normally under the conditions of mutual symbiosis; consequently they may be of some practical importance in forestry.

Nomenclature of the genus *Lactarius* was established by S.F. Gray (1821). Since Gray's study, many species of *Lactarius* have been classified and their partial and regional monographs published by many authors. According to "The *Agaricales* in Modern Taxonomy" by Singer (1975), 86 species of *Lactarius* were recognized. In Europe, however, Moser (1983) classified 96 species of *Lactarius*. Hesler and Smith (1679), on the other hand, recognized over 250 of *Lactarius* in North America. In Korea, 3 species of *Lactarius* were recorded by Uyeki (1936). Lee and Lee (1957, 1958 and 1959) reported 5 species of *Lactarius* in Korea.

Additionally 3 species of *Lactarius* were reported by Kim, D.S. *et al.* (1975). And Kim,

Y.S. *et al.* (1981 and 1982) recorded 6 unknown species of *Lactarius*. Besides these workers Kim, B.K. *et al.* (1976), Cho *et al.* (1979), Park *et al.* (1978, 1979) and Shin *et al.* (1984) added some species to Korean flora of *Lactarius*. Up to the present, 20 species, 1 variety and 1 form in *Lactarius* have been reported in Korea.

The Genus *Lactarius* in Korea were not intensely investigated at all. Consequently in this genus further examinations are required for some recorded species to correct and supplement their descriptions. Attempts were made by authors to collect wide range of *Lactarius* mushrooms in Korea and to classify them through a series of macro-and micro-scopical, and chemical experiments.

Materials and Methods

Collections and Preparations of Samples

Sample mushrooms were collected at Mt. Gyeryong, Mt. Chilgab, Mt. Ducyu, Mt. Chiri, Mt. Songri and the regions of Chungnam Province from July, 1983 to October, 1984.

Each sample was seperately kept in a paper bag and which labeled with the field notes including collection number locality and habitat, date and the characters for identification.

Sample mushrooms were spreaded and dried on a wire screen which located approximately 1 foot above the incandescent electric lamps for 2 days. After drying each sample was transferred to the original paper bag and kept in room temperature.

Examination and Identification

a) Macroscopic Examinations

Pileus: color, zonate or azonate surface, dry; viscid; glabrous; pruinose; squamulose; pubescent; tomentose. margin, glabrous; pruinose; tomentose; even; striate.

Lamella: color, does the color change with age or where bruised, distant, close arrangement, entire; branched

Milk: color; color change, taste

Stem: color, shape surface, dry; viscid; glabrous etc. solid or hollow

Flesh: color, does it change where broken, odor, taste

Size of plants

Habitat and habits

b) Microscopic Examinations

Spore: size, ornamentation, dot; ridges; bands or lines does it make a any reticulum.

Cystidia: size, cheilo-; macro- and pseudocystidia is prsent or not granule or hyaline in chemical reagents.

Basidia: size

Pileus trama

c) Chemical Examinations

Spore ornaments, cystidia and flesh were treated with;

(1) 10% FeSO4 solution

(2) 5% and 30% KOH solution

(3) sulphovanillin solution

(4) Melzer's solution, to observe the color reactions.

Results and Discussion

About 500 samples of mushrooms were colleted from the various regions in Korea from July, 1983 to October, 1984. They were classified through a series of intensive examinations. Among the samples, 19 species, 4 varieties and 1 form of *Lactarius* were found. Of these *Lactarii*, 9 species and 4 varieties of *Lactarius* appeared to be newly found ones.

These species were grouped into 6 sections of *Lactarius* according to Hesler and Smith (1979). The results were represented below in detail.

Lactarius Pers. ex S.F. Gray

Nat. Arr. Brit. Pl. **1**: 623. 1821.

Latex present, spore powder white to ochre-yellow and spores with warty to ridged or net-

like amyloid, external ornamentation, rounded to broad ellipsoidal. trama of the lamellae mostly not containing sphaerocysts, at least in the half closer to the edge.

Lactarius Pers. ex S.F. Gray
Nat. Arr. Brit. Pl. **1**: 623, 1821.

1. Latex blue, red, orange, injured tissues typically staining dull green rapidly or slowly .....1 *Latarius*
1*. Latex milk-like, whey-like or watery on exposure (rarely dull brown or cream-buff) 2
2. (1) Pileus velvety to unpolished and dry, color of pileus ranging from blackish to fuscous, drab, dingy buff to dull white; latex white, cream color but usually changing to reddish, vinaceous, lilac or violet or staining injured surfaces these colors; macrocystidia typically absent from hymenium ..... 2 *Plinthogalus*
2*. Not as above 3
3. Pileus dry and velvety to unpolished, not moist and hygrophanous, color not as in *Plinthogalus*, latex typically copious, milk-white to whey-like as exuded, changing and /or staining to brown or some other color (yellow, reddish etc.); macrocystidia frequently present and rarely with colored thickened walls; stipe never viscid. ..... 3 *Lactifluus*
3*. Not as above 4
4. (3) Pileus color ranging from black to fuscous, grey or pallid, often slimy viscid .....4 *Tristes*
4*. Not as above 5
5. (4) Basidiocarps having at least one of the following sets of characters:
   a) KOH on pileus cuticle instantly staining it purple to magenta.
   b) Pileus typically viscid and yellow to ochraceous; injured parts staining pinkish lilac to violet.
   c) Pileus margin bearded to fibrillose when young.
   d) Stipe hard and typically 10 mm or more thick; pileus often zonate and yellow to reddish orange.
   e) Pileus±hairy to fibrillose overall including margin, often becoming±glabrous; hyphal incrustations, lacking in cuticular region of pileus. .....5 *Piperites*
5*. Not as in any of above choices; stipe fragile and often hollow by maturity, 2~10 mm thick; pileus viscid to moist or in age± squamulose-areolate from breaking up of cuticle; lacking dextrinoid incrustations on hyphae of cuticular zone of pileus ..... 6 *Russularia*

Lactarius

1. *Lactarius hatsudake* Tanaka, *Bot. Mag. Tokyo*, **4**: 393, pl. 15. 1890. 젖버섯 아재비.
   Uyeki (1936):2; Lee and Lee (1958):9; Lim and Kim (1972): 15.
   Ill.: Imaz. & Hongo (1957):97, pl. 45, f. 258; Ito (1959):506.
2. *Lactarius akahatsu* Tanaka, *Bot. Mag. Tokyo*, **4**: 394, 1890. 피 젖버섯
   Uyeki (1936):2; Lee, J.Y. (1957): 5; Lim and Kim (1972):15.
   Ill.: Ito(1959):506; Hongo (1977): 40, f. 4 (7~9).

Pileus 4~10 cm or more broad, convex, then flattened and depressed, surface viscid when moist, glabrous, orange to grayish orange, zoned, staining greenish with age; margin incurved when young. Flesh firm, thick, orange white to whitish; taste mild, odor none.

Lamellae decurrent, crowded, 4~5 mm broad, orange, becoming stained with green where wounded.

Stipe 3~6 cm long, 1.2~2 cm thick, subequal,

more or less rugulose, concolorous, downy at base, hollow. Latex orange slowly becoming vinaceous red, mild or slightly acrid, scanty.

Spores 7~8.5×5~6.2 μ, broadly ovoid, coarsely reticulated with warts, up to 0.3~0.5 μ high.

Basidia 32~42×8.5~10 μ, 4-spored; cheilocystidia abundant, 23~36×5~8 μ, narrowly fusoid, lanceolate, or subcylindric, sometimes septate, thin-walled; pleurocystidia difficult to demonstrate.

Habitat: Gregarious or scattered, in Pinus forests.

Distribution: Korea, Japan and North America.

Plinthogalus

3. *Lactarius gerardii* Peck, *Ann. Rep. N.Y. St. Mus.* **26**:65, 1874. 애기 젖버섯
   Lee, J.Y. (1975):28.
   Ill.: Hongo (1971):67, f. 34(3-6); Hesler and Smith (1979):111, pl. 19-20, figs. 37-38, 180.
4. *Lactarius lignyotus* Fr., *Mon. Hymen. Suec.* **2**:177, 1863. var. *lignyotus* Hesler & Smith 잿빛 헛대 젖버섯
   L. lignyotus: Kim, Kim, Park and Hongo (1975):32
   Ill.: Graham (1944):220, pl. 5, f. 4; Moser (1983): 453-Ito(1959): 185, f. 207...*L. lignyotus* Hesler & Smith (1979):127, f. 23-24, 175. (*lignyotus*)
5. *Lactarius lignyotus* var. *nigroviolascens* (Atk. in Burl.)
   Hesler & Smith, *Nor. Am. Sp. Lac.*: 131, pl. 156, f. 27, 1979. 보라잿빛 헛대 젖버섯(신칭)
   Lactaria nigroviolascens Atk., in Burl., *Mycologia* **24**:461, 1932.

Pileus 3~8 cm wide, broadly convex, becoming convex-depressed, expanding to plano-depressed or shallowly infundibuliform usually with a small umbo or papilla, surface more or less rugose to even, pruinose to velvety, dry; blackish brown to dark yellow-brown, in age a paler dingy yellow-brown with the center usually remaining darker; margin even. Context white, staining dark violet when cut or bruised; odor pungent, taste mild. Latex abundant to scanty, white, slowly changing to dark violet when exposed, staining all parts dark violet where injured; taste pungent but not acrid.

Lamellae adnate, decurrent; distant to subdistant, white becoming ochraceous, the edges concolor with the faces.

Stipe 9~10 cm long, 5~10 mm thick at apex, usually equal or nearly so, often plicate at apex as in *L. lignyotus* var. *lignyotus*, concolorous with pileus or paler, base whitish.

Spores in deposit yellow, spores 10.8~13 μ including ornamentation, globose to subglobose, with up to 2 μ warts, coarse ridges and bands, the whole forming a partial to±complete reticulum marked by adhering amyloid debris.

Basidia 45~60×8~12 μ, 4-spored, clavate, broadest near the apex, hyaline in KOH but the content oily-granular. Pleurocystidia: macrocystidia none; pseudocystidia filamentous, scattered to rare. Cheilocystidia mostly 30~60×3~6 μ and more or less filamentous, some ventricose at base and with a filamentose apical prolongation 20~40 μ long and 4~6 μ wide, some with one to three finger-like prolongations and in these the apex at times enlarged to 12 μ, hyaline or rarely with pale brownish content as revived in KOH.

Habitat: Solitary to gregarious in conifer forests on humus or on sphagnum, late summer and fall.

6. *Lactarius sumstinei* Peck, *Bull. Torrey Bot. Club* **32**:78, 1905 우산주름 젖버섯(신칭)
   Ill.: Hesler & Smith (1979):110, pl. 31, f. 52.

Pileus 4~8 cm broad, convex then depressed, very pale alutaceous, azonate, dry, appearing glabrous, smooth or faintly radiately rugulose, margin even or plicate. Context whitish, thin; taste acrid. Latex white, unchanging and not staining the context or lamellae, acrid.

Lamellae adnate becoming decurrent, putty colored (pinkish buff), broad, distant, pale, the edges even.

Stipe 5~9 cm long, 9~12 mm thick, putty colored (pinkish buff) dry, glabrou. equal, firm.

Spores from sections 7.5~9 μ (excluding ornamentation), globose to subglobose; ornamentation in the form of prominent ridges some of which branch and forming a broken to complete reticulum with prominences±2 μ high.

Basidia 52~67×9~12 μ, 4-spored. Pleurocystidia: macrocystidia none; pseudocystidia present, filamentous, contorted, content granular. Cheilocystidia not well delimited, ±filamentose to narrowly subfusoid, apex obtuse to subacute, hyaline in KOH.

Habitat: Grassy places in often woods, late summer.

Observation: The pale alutaceous pileus, acrid taste, nonchanging or staining latex, broad distant gills, ±reticulate spores with ornamentation about 2 μ high, and a glabrous pileus distinguish this species from others.

Lactifluus

7. *Lactarius volemus* (Fr.) Fr., *Epicr. Myc.* 344, 1838. 배 젖버섯
   Lee and Lee (1957):2
   Ill.: Imaz. & Hongo (1957):95, pl. 44, f. 248; Ito (1959):482, f. 205; Rinaldi & Tyndalo (1974):135; Hesler & Smith (1979):162; Phillips (1981):88; Moser (1983):459.
8. *Lactarius subvellereus* Peck, *Bull. Torrey Bot. Club* 25:369, 1898. 새털 젖버섯 아재비
   Kim, Y.S. *et al.* A Mem. Research work (title translated).
   Ill.: Chiu (1945):34, f. 6; Imaz. & Hongo (1957):97, pl. 45, f. 257; Ito (1959):498, f. 211.
   var. *subvellereus* Hesler & Smith, *Nor. Am. Sp. Lac.*: 202, figs. 164-64a.
9. *Lactarius subvellereus* Pk. var. *subdistans* Hesler & Smith, *Nor. Am. Sp. Lac.*: 203, pls. 42~43, fig. 217, 1979. 노란주름 융단 젖버섯(신칭)

Pileus 5~13 cm broad, convex, depressed to vase-shaped, white tinged yellowish or more rarely grayish, velvety to tomentose drying white to grayish white; dry, azonate, margin even.

Context white, becoming yellowish or sordid when cut; compact and hard, medium thin; odor mild or fungoid, taste acrid. Latex white, changing to dull yellow on exposure to air, typically drying creamy yellow to ivory-yellow on the tissue of the basidiocarp; very strongly acrid.

Lamellae adnate to subdecurrent, white, becoming yellowish at maturity (darker when dried), often beaded with hyaline droplets when fresh, brownish eventually where injured, close to subdistant or in age distant, narrow to moderately so, forking to some extent, lamellulae numerous, when dried buff to fawn color.

Stipe 2~5 cm long, 12~35 mm thick, white, tinged yellowish or brownish, when dried more or less concolorous with the pileus velvety, hard, solid, equal.

Spore deposit white. Spores 6~7.5×5~5.5 μ, ellipsoid to broadly ellipsoid, ornamented with low warts, lacking interconnecting lines or ridges, prominences±0.2 μ or less high.

Basidia 52~60×8~10 μ, 4-spored. Pleurocystidia 60~80×8~10 μ, subfusoid-acute, toward apex often with one or more constrictions, con-

tent±granular revived. Cheilocystidia 45~60×4~6 μ, similar to pleurocystidia.

Habitat: On soil in deciduous or mixed forests, common during July and August.

Observation: This variant's yellow and distant gills is similar as *L. vellereus*, but *L. vellereus* has larger spores, 9~11×7.5~8.5 μ.

10. *Lactarius vellereus* (Fr.) Fr., *Epicr. Myc.* 340, 1838. var. *virescens* Hesler & Smith, *Nor. Am. Sp. Lac.*: 201, pl. 41, f. 221. 푸른주름융단 젖버섯(신칭)

Pileus 4~15 cm broad, convex-depressed, often sinuate on one side, surface dry and unpolished to velvety, milk-white over-all at first, soon flushed or stained ochraceous, and finally darkening to dingy cinnamon-buff. Context thick, brittle, white, slowly staining cinnamon-buff, acrid. Latex milk-white, unchanging, staining gills dingy ochraceous, scanty, acrid.

Chemical reactions: FeSO4, pinkish cinnamon, going to dark brown; KOH,-

Lamellae close to crowded, hard, subnarrow, decurrent, many tiers of lamellulae present, dull white, with a flush of greenish near stipe and /or all of the lamellae, soon stained cinnamon-buff where injured.

Stipe 3~6 cm long, 1.5~3 cm thick, tapered downward, solid, stuffed, surface dull white, dry and covered overall by a dull whitish pubescence, slowly staining dingy ochraceous but not discolored as much as the gills.

Spore deposit dull white. Spores 6.5~8.3×6~6.7 μ, broadly ellipsoid to subglobose; ornamentation of small warts and low ridges forming an obscure broken reticulum, prominences±0.2 μ high.

Basidia 45~55×8~12 μ, 4-spored. Pleurocystidia 46~60×8~9 μ, narrowly fusoid to subcylindric, often with constrictions near apex, content often granular. Cheilocystidia 52~60×4.5~7 μ, ±similar to pleurocystidia.

Habitat: Gregarious under deciduous trees and shrubs.

Observation: This variant is placed in *L. vellereus* because of its wide spore, scanty latex, the epicuticular hairs of the pileus and stipe, and negative KOH reaction of the latex.

It differs in the green flush of the gills and their close spacing. But author's specimens have smaller spores than Hesler & Smith's one, 7.5~9×7.5~9 μ.

11. *Lactarius piperatus* (Fr.) S.F. Gray, *Nat. Arr. Brit.* Pl.: 1:623, 1821. 굴털이
Uyeki (1936):2; Lee and Lee (1957):3.
Ill.: Graham (1944):218, pl. 24, f. 21; Imaz. & Hongo Uyeki (1936):2; Lee and Lee (1957):3.
Ill.: Graham (1944):218, pl. 24, f. 21; Imaz. & Hongo (1957):97, pl. 45, f. 256; Ito (1959):486, f. 209; Rinaldi & Tyndalo (1974):130; Phillips (1981):77; Moser (1983):451.
var. *piperatus* Hesler & Smith, *Nor. Am. Sp. Lac.*: 185, pl. 36, figs. 80-81.

12. *Lactarius piperatus* var. *glaucescens* (Crossl.) Hesler & Smith, *Nor. Am. Sp. Lac.*: 186, pl. 37, figs. 188'220. 녹색젖 굴털이(신칭)
L. glaucescens Crossland, Naturalist 1900:5, 1900. in 'Moser (1983):451'.

Pileus 4.5~7 cm broad, when young convex with an inrolled margin and a depressed disc, becoming±plano-convex; dry; glabrous, principally "catridge-buff" with some areas tinged "cream-buff" to "dingy yellow-brown." Context 5~10 mm thick in the disc, hard, pale cream color, unchanging when cut; with pungent odor. Latex pale cream color, unchanging on exposure, but becoming dingy pale green when dried; strongly acrid.

Lamellae very narrow, 1~1.5 mm broad,

arcuate-decurrent, crowded, often forked, with entire edges, dull cream color.

Lamellulae numerous.

Stipe 3.5~10 cm long, 10~22 mm thick, usually tapering to the base or equal, glabrous, solid, concolorous with pileus or paler.

Spore deposit yellowish in a heavy deposit. Spores 6~8.6×5.5~6.5 μ, broadly ellipsoid, ornamentation of very low warts and fine lines quite pale in Melzer's reagent, not forming an evident reticulum or partial reticulum; prominences-0.2 μ high. Basidia 30~45×7.5~9 μ, 4-spored. Pleurocystidia: macro.; not distinct from pseudocystidia, ±basidium-like to ventricose with rounded apex and most numerous near gill edge, content±granular, 50~67×7~8 μ.

Habitat: Scattered on moss-covered soil in deciduous woods.

Distribution: Korea (Mt. Songri), North America and Europe.

13. *Lactarius piperatus* f. *pergamenus* (Fr.) Imai 주름 젖버섯

L. pergamenus (Swartz ex Fr) Fr., *Epicr. Myc.* 340, 1838. in "Moser (1983):451"

Lee, J.Y. (1975):28.

Ill.: Ito (1959):487.

Observation: This variant differs in very rough pileus surface from var. *glaucescens*, and pale green latex when dried from var. *piperatus*.

14. *Lactarius hygrophoroides* Bert. & Curt., *Ann. Mag. Nat. Hist.* 3rd Ser. **4**:293, 1859. 흰주름 젖버섯

Kim, *et al.*, A Mem. Res. Work (title translated), Ins. Agr. Sci. 1978.

Ill.: Graham (1944):223, pl. 24, f. 19; Imaz. & Hongo (1957):95, pl. 44, f. 183; Hesler and Smith (1979):171, fig. 183.

15. *Lactarius luteolus* Peck, *Bull. Torrey Bot. Club* **23**:412. 1896. 갈색끈적 젖버섯(신칭)

Ill.: Graham (1944):223; Ito (1959):484; Hesler & Smith (1979):166, pl. 30, figs. 76~77, 190, 215; Moser(1983):459.

Pileus 2.5~6 cm broad, convex, plane or umbilicate, white or whitish to buff, dry, becoming brownish in age or on drying pruinose-velvety, sometimes somewhat rugulose, azonate or depressed zone near the margin. Context whitish, staining brown; odor mild or more or less strong, fetid, taste mild. Latex copious, sticky, white, unchanging, staining brown, abundant, taste mild.

Chemical reactions: FeSO4, bluish-olive on cut context; KOH-slightly orange-buff.

Lamellae adnate to subdecurrent, white becoming yellowish, brown where bruised, close, narrow to moderately broad, some forking near the stipe.

Stipe 2.5~6 cm long, 5~12 mm thick, white or whitish to buff staining brown, dry, pruinose-velvety, equal, stuffed, very sticky.

Spore deposit white to cream color. Spores 7~8.5×6~7 μ, ellipsoid; prominences 0.3~0.5 μ high, mostly isolated warts, a few connected by lines.

Basidia 32~43×6~8 μ, 4-spored. Pleurocystidia as pseudocystidia 47~70×3~6 μ, flexu subcylindric, at times subcapitate or±ventricose, ous to buried, inconspicuous. Cheilocystidia 28~40×3~5 μ, ventricose, filamentous, often capitate, thin walled. Pileus cuticle celular, bearing a turf of pileocystidia, the elements with thin to thick walls, 34~70×3~5 μ, filamentous, often capitate. Stipe cuticle of repent hyphae; caulocystidia 33~75(125)×2~4 μ, many of them thick-walled, filamentous, often capitate and septate, forming a turf.

Habitat: On soil, in deciduous and mixed woods, abundant.

Distribution: Korea (Daejeon, Mt. Gyeryong), Japan, Nor. Am. and Texas, June-September.

Observation: This species is characterized by its small to medium stature, whitish or pale yellow colors at first, minutely but distinctly velvety pileus surface, rather small spore conspicuous brown stains from the latex, sticky latex and basidiocarps, and the more or less capitate pileocystidia and caulocystidia.

Tristes

16. *Lactarius pyrogalus* (Fr.) Fries, *Epicr. Myc.* 336, 1838. 제브라 젖버섯(신칭)

Ill.: Graham (1944):218; Hesler & Smith (1979):373, pl 63-94, f. 227; Phillips (1981):85 (not correctly described of spore ornamentations); Moser (1983): 458.

Pileus 4-8 cm broad, plano-convex, becoming depressed, margin inrolled, grayish olive-brown to yellowish brown or gray sometimes with a slight purplish hue, lubricous to slightly viscid. Context white, becoming slightly creamy yellow after exposure to air a long time, sometimes tinged color of pileus; odor, mild, or of apple but with a resinous component, taste acrid. Latex with a slight yellowish appearance, drying yellowish on bruised places, not staining, taste acrid.

Lamellae adnate to subdecurrent, pale yellowish, then ochre yellow, subdistant to distant, lamellulae present.

Stipe 3-7 cm long, 5-12 mm thick, whitish or pallid, with a slight tone of the pileus color, dry or at times lubricous to viscid.

Spores 6-7.5×5-6 μ, broadly ellipsoid; ornamentation in a zebroid pattern of mostly unbranched ridges of variable length- not forming a reticulum to any degree; prominences 0.5-1 μ high.

Basidia 4-spoered, 37-45×7.5-9 μ. Pleurocystidia: macrocystidia prominently projecting, scattered, 80-116×7.5-9 μ subcylindric to narrowly fusoid, pointed at maturity, some are elongate-fusoid-ventricose. Cheilocystidia scattered, smaller than macrocystidia. Pileus cuticle a thick refractive more or less gelatinous, ixocutis, the hyphae 3-6 μ wide hyaline in KOH.

Observation: Its zebra-like patterns in ornamentation and very large macrocystidia are very distinct. This species resembles *L. circellatus* but it differs in more zebra-like spore ornamentation and subdistant to distant lamellae and also large macrocystidia (?).

17. *Lactarius argillaceifolius* Hesler & Smith var. *argillaceifolius* Hesler &Smith, *Nor. Am. Sp. Lac.* 366, pls. 68-69, figs. 125-27. 흑갈색주름 젖버섯(신칭)

Pileus 4-15 cm broad, broadly convex-depressed, expanding toplano-depressed or shallowly infundibuliform near dull-lilac or drab color, "cinnamon-drab" becoming "drab gray"; azonate, slimy viscid when wet. Context fleshy-firm, whitish or stained tan, taste mild, odor not distinctive. Latex dull cream color when first exposed (not pure white), staining the lamellae grayish brown going to tan, or olivaceous at first, taste slightly burning-acrid or mild.

Lamellae narrow becoming broad, close, decurrent, pale cream color young, staining brown where cut or olivaceous to brown to tan.

Stipe 6-9 cm long, 1.5-2 cm thick, equal, pith brown in age.

Spore deposit pinkish buff. Spores 8.6-11.9×7.5-9.2 μ including ornamentation, subglobose to broadly ellipsoid; ornamentation of isolated warts and ridges, the edges often branching and forming at most a broken reticulum, prominences 0.5-1 μ high.

Basidia 45-52×9-10.5 μ, 4-spored. Pleurocystidia: macrocystidia 108-127×11 μ fusoid-ventricose with a pointed apex, content granular-spangled as revived in KOH, arising in the gill trama, abundant and prominently projecting;

pseudocystidia scattered, content refractive, filamentous. Cheilocystidia 32-67×6-9 μ, similar to pleurocystidia.

Habitat: Solitary in deciduous woods, rare.

Distribution: Korea(Mt. Songri), North America and Canada.

Piperites

18. *Lactarius chrysorrheus* Fr. *Epicr. Mycol.* 342, 1838. 노란 젖버섯
Kim *et al.*, A Mem. Res. Work(title translated), Ins. Agr. Sci.: 1978.
Ill.: Ito (1959): 499, f. 217; Rinaldi & Tyndalo (1984): 130; Hesler & Smith (1979): 313, pls. 112-13 figs. 153-54; Moser (1983): 455.

19. *Lactarius repraesentaneus* Britz. sensu Neuhoff, *Neuhoff Die Milchlinge*: 111, 1956. 보라빛주름 젖버섯(신칭)
Ill.: Miller (1978):73, pl.58. ; Hesler & Smith (1979): 227, pls. 89-90, f. 87; Moser (1983): 452, f. 329

Pileus 4-12 cm broad, convex-depressed to planodepressed but usually the margin arched, with varying degrees of viscidity depending on the weather, with an overlay of fibrils more coarse and numerous toward margin (disc±glabrous at times); color pale to rich yellow or orange-yellow, developing clay color to rusty tints over central area, staining purplish where bruised, the fibrils at first pallid becoming yellowish and finally often±clay color, surface faintly zoned. Context whitish, quickly stained dull lilac to purple firm, brittle, odor and taste not distinctive or sometimes the odor faintly fragrant, taste mild or slightly acrid.

Latex white to cream color, copious, in contact with flesh changing to violaceous or lilac, mild to slightly acrid, of ten becoming whey-like to watery, rather viscous at first.

Lamellae close to crowded, narrow to moderately broad, cream color to pale ochraceous, soon spotted lavender to purplish where injured, some forked near the stipe.

Stipe 5-12 cm long, 1-3 cm thick, equal, soon hollow, whitish to±concolor with pileus, staining as for gills where injured.

Spore deposit yellowish. Spores variable in size 8.6-11.3×7-9 μ, broadly ellipsoid to ellipsoid, ornamentation in the form of warts and ridges and sparcely branched bands not into any sort of reticulum; the prominences 0.6-1 μ high.

Basidia 60-70×10-14 μ, clavate, 4-spored. Pleurocystidia: macrocystidia 70-120×10-12 μ, fusoid to fusoid-ventricose with a long tapered neck ending in a sharp point, less frequently with a small apical capitellium or one or more subapical constrictions; content hyaline; pseudocystidia apparently absent to rare. Cheilocystidia similar to macrocystidia but usually smaller, scattered.

Habitat: Common in mixed woods.

Distribution: Korea (Mt. Songri), Nor. America and Europe.

Observation: Collections in Korea have shorter fibrils than North American ones, but other characters are very same as discriptions of North American authors.

Russularia

20. *Lactarius subzonarius* Hongo, *Journ. Jap. Bot.* **32**(7):212 fig.3, 1957. 당귀 젖버섯
Kim, Kim, Park and Hongo (1975):32.
Ill.: Ito (1959):459; Imaz & Hongo (1965): 111, pl.35, f.207; Hesler & Smith (1979): 566.

Pileus 2.5-5 cm broad, soon depressed, becoming infundibuliform, plae flesh color to cinnamon-brown, not viscid, concentrically zonate, with minute fibrillose scales (seen under lens). Context pallid, not thick, odor very strong. Latex white, unchanging, staining the gills brown,

taste mild or sweet.

Lamellae adnate-decurrent, pale flesh, becoming brown where touched, crowded, narrow, ocassionally forked.

Stipe 2.5-3 cm long, 5-7 mm thick, subequal, brownish rufous, white-pruinose, rugulose, ocassionally compressed, hollow, base brownish strigose.

Spore deposit cream. Spores 7-8.5×7-8 μ, globose or subglobose; warts 0.5-1 μ high, with broad and narrow bands forming a reticulum.

Basidia 36-40×7-9 μ, 4-spored. Pleurocystidia none (the cheilocystidia may extend up sides 50-85 μ). Cheilocystidia, 22-30×4-6 μ, ventricose, subclavate, moderately abundant.

Habitat: On soil under *Quercus* trees.

Observation: This species is characterized by pale flesh color to cinnamon-brown, zonate, dry pilei; its strong odor; its white, mild latex which stains the lamellae brown; its lack of pleurocystidia; and the development of fenugreek odor when stored.

21. *Lactarius mutabilis* Peck, *Ann. Rep. N.Y. St. Mus.* **43**:20, 1890. 진갈색무늬 젖버섯 (신칭)

Ill.: Hesler & Smith (1979):469, pls. 133b, 140, f.198.

Pileus 3-8 cm broad, at first subspherical, finally expanded, zonate when wet, subviscid, zones dark, the interzonal areas "avellaneous," disc dark, subpruinose under a lens, margin faintly striate when wet. Context thick on disc, thin on margin, concolorous with the pileus surface; odor mild, taste mild. Latex white or somewhat watery white, unchanging not staining, taste mild. Lamellae adnate or subdecurrent, whitish, becoming tinged yellowish avellaneous or stained dingy reddish, close, narrow to medium broad, lamellae present, few forking at base.

Stipe 3-8 cm long, 6-10 mm thick, concolorous with the pileus, or the apex paler, equal, glabrous, hollow, dry.

Spore deposit whitish. Spores 7-9×5.5-7.5 μ, warts 0.4-0.7 μ high, bands, branches, and a few lines forming a reticulum (partial).

Basidia 36-42×7-9 μ, 4-spored. Pleurocystidia; macrocystidia 45-70×5-10 μ, ventricose-acuminate to subclavate. Cheilocystidia 27-34×4-6 μ, su bventricose-acuminate to flask-shaped.

Habitat: On soil, in coniferous and mixed woods.

Distribution: Korea and North America.

Observation: *L. mutabilis* is distinguished by its mild taste, zonate pileus before fading, dull brown colors, white to watery white latex and whitish then yellowish lamellae.

22. *Lactarius thejogalus* (Fr.) S.F.Gray, *Nat. Arr. Brit.* Pl. **1**:624, 1821. 갈황색 젖버섯 (신칭)

Ill.: Graham (1944):218; Ito (1959): 494, f.214; Hesler & Smith (1979):520, pls. 88b, 148a, figs. 182, 244, 141-42; Moser (1983):461.

Pileus 2-7.5 cm broad, obtuse to convex with a decurved margin, then depressed and slightly infundibuliform, with a low acute umbo, ferruginous to orange-cinnamon or finally orange buff or dull rufous, moist but never viscid, azonate. Context firm but brittle, odor not distinctive, dull white to pale vinaceous. Latex white, usually staining yellow slowly, slowly slightly acrid or mild.

Lamellae decurrent, close to crowded, narrow, with many tiers of lamellulae, pale pinkish buff, becoming darker.

Stipe 4-6 cm long, 10-15 mm thick, concolorous with the pileus or paler, equal.

Spore deposit white if thin, yellowish in heavy deposits.

Spores 8-10.3×6.5-8.2 μ, broadly ellipsoid,

ornamentation in the form of blunt cones and warts or rather irregular, catenulate rides connected by fairly fine lines or unconnected, the prominences 0.4-0.8 μ high.

Basidia 28-37×7-10 μ, 4-spored, yellowish in KOH. Pleurocystidia: macrocystidia 48-85×7-11 μ, fusoid; contentrefractive and dingy yellowish in KOH, pseudocystidia filamentous. Cheilocystidia 30-45×5-7 μ, similar to the pleurocystidia but smaller.

Habitat: In leaf-mold in sphagnum, or on soil, under hardwoods or in mixed forests.

Distribution: Korea, Europe and North America.

23. *Lactarius gracilis* Hongo, *Journ. Jap. Bot.* **32** (5): 144, f. 2 (g-h). 1957. 애기털 젖버섯 (신칭)

Ill.: Ito (1959): 491; Imaz. & Hongo (1965): 110, pl.35 f. 206.

Pileus 1-2(2.5) cm wide, rather convex, then plano-depressed with acute papilla; dry; azonate; minute granuloso-subvelutinous, brown in center, light brown or subavellaneous in marin; margin at first incurved, bearded; flesh light brown; latex white, unchanging, mild.

Lamellae adnate-decurrent, close to subdistant, often forked, pale flesh, spotted dirty brown when bruised; 2 mm broad.

Stipe 2-5 cm long, 2-3 mm thick, equal or subattenuate towards apex; curved; hollow; red-brown; surface whitepruinose at base strigose.

Spore deposit dull white; spores subglobose, l-guttulate, 7-8×7-7.8 μ (excluding ornamentation), up to 1 μ wart, forming a partial reticulum.

Basidia 35-46×7.5-11 μ, 4-spored; cheilocystidia sparce 25-28×6.5-9.5 μ, thin-walled; clavate, rather difficult to demonstrate, hyaline in KOH.

Habitat: Gregarious or scattered, among mosses or fallen leaves in deciduous woods in summer.

Distribution: Korea (Daejeon), and Japan.

Observation: The shaggy edge of the cap, the slender stem and the white, mild-milk are the distinguishing characteristics of this species. Rather common.

24. *Lactarius cyathula* (Fr.) Fr. forma *japonicus* Hongo, *Mem. Shiga Univ.* **21**:66, f. 34(1-3), 1971. 애기낙엽 젖버섯(신칭)

Ill.: Pileus 1~3 cm broad, flattened then depressed, usually papillate, surface glabrous, sordid orange-brown, darker in the center, radially rugulose, somewhat translucent-striate when

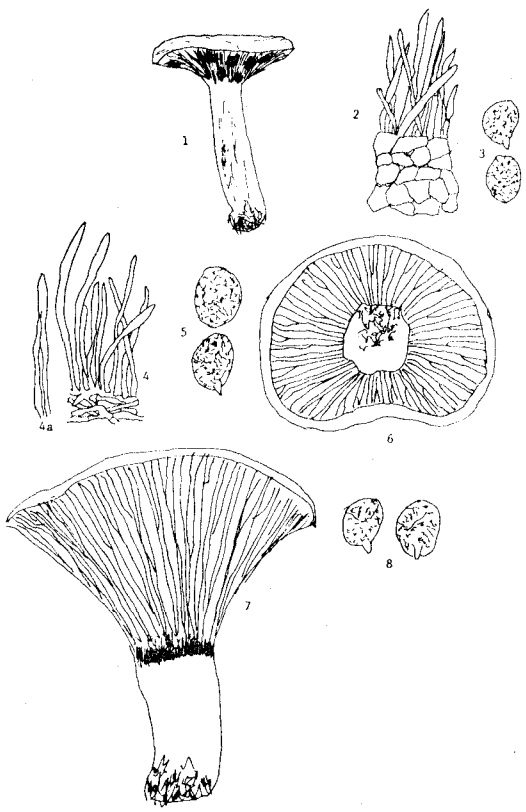

Fig. 1. *Lactarius piperatus* v. *glauscens:* 1. carpophore; 2. cellular cuticle with cystidia turf; 3. spores

L. subvellereus v. *subvellereus:* turf type dry cuticle; 4a, a portion of pileocystidia, *L. subvellereus* v. *subdistans:* 5. spores; 6. carpophore

L. vellereus v. *virescens:* 7. carpophore; 8. spores

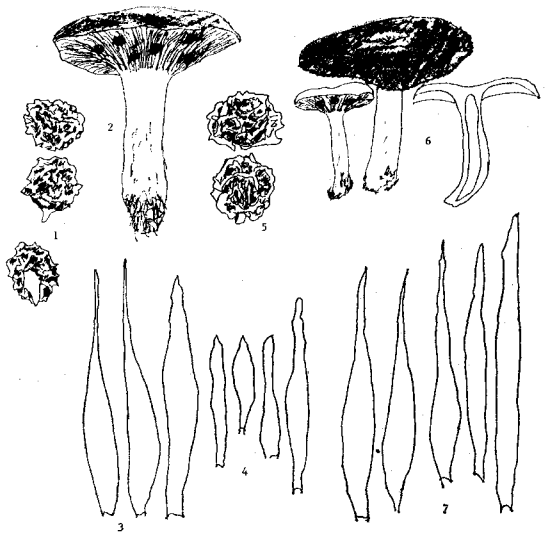

Fig. 2. *Lactarius argillaceifolius:* 1. spores; 2. carpophore; 3. macrocystidia; 4. cheilocystidia *L. repraesentaneus*: 5. spores; 6. carpophores 7. macrocystidia

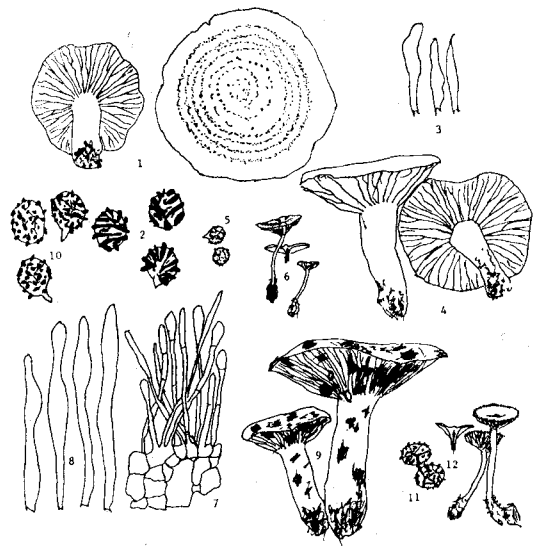

Fig. 3. *Lactarius pyrogalus:* 1. carpophore; 2. spores *L. sumstinei:* 3. cheilocystidia; 4. carpophores *L. cyathula* f. *japonicus:* 5. spores; 6. carpophores *L. luteolus:* 7. pileus cuticle; 8. macrocystidia; 9. carpophores; 10. spores *L. gracilis:* 11. spores; 12. carpophores

moist. Flesh very thin, concolorous with the surface, odor none. Milk white, scanty, taste mild.

Lamellae adnate or adnate-subdecurrent, distant, unbranched 1~4 mm broad, cremeous, then ochraceous-buff to flesh color.

Stipe 1~5 cm long, 1~3 mm thick, slender, often flexuous, equal, glabrous, reddish brown, paler at the apex, hollow, the base often covered with whitish or tawny hairs.

Spores pale cream in mass, subspheric oval, 7.5~10.8×6.5~9 μ, warty-spinulose and subreticulate; basidia 4-spored 33~40×1~12 μ.

Habitat: Gregarious on the ground in forests, espicially under oaks.

Distribution: Korea and Japan.

Observation: *L. cyathula* differs in habit. *L. cyathula* grows in *Sphagnum* bogs or in damp places, but this variant is found under oaks.

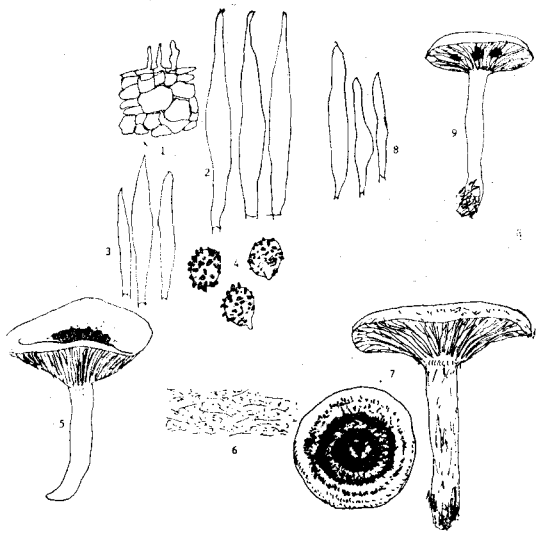

Fig. 4. *Lactarius thejogalus:* 1. pileus cuticle; 2. macrocystidia; 3. cheilocystidia; 4. spores; 5. carpophores *L. mutabilis:* 6. ixocutis; 7. carpophores *L. lignyotus* v. *nigroviolascens:* 8. cheilocystidia; 9. carpophores

摘 要

1983年 7月부터 84年 10月까지 地異山, 俗離山, 德裕山, 七甲山, 鷄龍山 地域 및 忠南一圓에서 젖버섯 屬에 속하는 菌類들을 採集하여 分

類한 結果 *Lactarius* 19종, 4변종 및 1 form이 同定되었다. 이들 *Lactarius*를 Hesler 및 Smith (1979)의 體係에 따라 6 section으로 나누었으며 이중 韓國에서 처음 발견된 버섯은 다음과 같다.

L. lignyotus var. *nigroviolascens* (Atk.) Hesler & Smith 보라잿빛 헛대 젖버섯,

L. sumstinei Pk. 우산주름 젖버섯,

L. subvellereus var. *subdistans* Hesler & Smith 노란주름융단 젖버섯,

L. vellereus var. *virescens* Hesler & Smith 푸른주름융단 젖버섯,

L. piperatus var. *glaucescens* (Crossl.) Hesler & Smith 녹색젖 굴털이,

L. luteolus Pk. 갈색끈적 젖버섯,

L. pyrogalus (Fr.) Fr. 재브라 젖버섯,

L. argillaceifolius var. *argillaceifolius* Hesler & Smith 흑갈색주름 젖버섯,

L. repraesentaneus Britz. 보라빛주름 젖버섯,

L. mutabilis Pk. 진갈색무늬 젖버섯,

L. thejogalus (Fr.) S.F. Gray 갈황색 젖버섯,

L. gracilis Hongo 애기 털 젖버섯,

L. cyathula f. *japonicus* Hongo 애기낙엽 젖버섯,

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