

Taxonomic Studies on the Genus *Russula* of Korea

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韓國產 木菌屬의 分類學的 研究

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Abstract: Mushrooms were collected from those grown at Mt. Gyeryong, Mt. Chilgab, Mt. Ducyu, Mt. Chiri, Mt. Songri and at the regions of Chungnam Province during the period from July, 1983 to October, 1984. They were classified into 30 species, two varieties and one form of *Russula*. These species were grouped into eleven sections. Of the classified species, *Russula subnigricans* Hongo, *R. albonigra* (Kromb.) Fries, *R. cyanoxantha* (Kromb.) Fries, *R. cyanoxantha* var. *peltereaui* Singer and *R. compacta* Prost et Pk were newly recorded in Korea.

Keywords: *Russula subnigricans*, *Russula albonigra*, *Russula cyanoxantha* var. *peltereaui*, *Russula compacta* Prost et Pk.

Many of the genus *Russula* mushrooms including *Russula cyanoxantha* and *R. virescens* are edible and have been used for food in Europe and Asia, but *R. foetens* and *R. subnigricans* are known to be poisonous. The majority of the genus *Russula* occurring in temperate zones are considered as obligatory mycorrhizal fungi which form ectotrophic mycorrhiza with forest trees of conifers and broad-leaved families, living normally under the conditions of mutual symbiosis. Consequently they may be of some practical importance in forestry.

Since nomenclature of the genus *Russula* was established by Gray (1821), various species of *Russula* have been reported and their practical and regional monographs were published by many authors. According to "The Agaricales in Modern Taxonomy" by Singer (1975), 275 species of *Russula* were recognized. In Europe,

Moser (1983) classified 161 species of *Russula*. In Korea, two species of *Russula* were initially recorded by Uyeki (1936) and then later 14 species were added by Lee (1957, 1958 and 1959) and four species by Kim *et al.* (1975). Kim *et al.* (1977) revised Korean species of *Russula* and reported, three unrecorded species. Besides these works Kim *et al.* (1976), Cho *et al.* (1979) and Shin *et al.* (1984) added some species respectively. Up to the present, 37 species, two varieties and one form of *Russula* have been reported in Korea.

Except for the revision of the genus *Russula* by Kim *et al.* (1977), there have been no extensive investigations of the genus *Russula*. Attempts were made by authors to collect of *Russula* mushrooms in Korea and to classify them through a series of macro- and micro-scopical, and chemical experiments in order to supplement the

descriptions of this genus.

Materials and Methods

Collections and Preparations of Samples

Mushroom samples were collected at Mt. Gyeongryong, Mt. Chilgab Mt. Duckyu, Mt. Chiri, Mt. Songri and the regions of Chung Nam Province from July, 1983 to October, 1984.

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

Mushroom samples were spread and dried on a wire screen which located approximately one foot above the incandescent electric lamps for two days. After drying each sample was transferred to the original paper bag and kept in room temperature.

Examination and Identification

1) 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
- Stem: color, shape
surface, dry; viscid; glabrous etc.
solid or hollow
- Flesh: color, does it change where broken, odor, taste
- Size of mushrooms
- Habitat and habits

2) Microscopic examinations

- Spore: size, ornamentation, dot; ridges; bands or lines does it make a any reticulum.
- Cystidia: size, cheilo-; macro-and pseudocystidia is present or not

granule or hyaline in chemical reagents.

• Basidia: size

• Pileus trama

3) Chemical examinations

Spore ornaments, cystidia and flesh were treated with;

- (1) 10 % solution of FeSO₄,
- (2) 5 % and 30 % solution of KOH,
- (3) sulphovanillin solution, and
- (4) Melzer's solution, to observe the color reactions.

Results and Discussions

About 500 samples of mushrooms were collected from the various regions in Korea from July, 1983 to October, 1984. They were classified through a series of intensive examinations.

Among the samples, 30 species, two varieties and one form of *Russula* were found.

Of these *Russulas*, three species and one varieties of *Russula* appeared to be newly found ones.

These species were grouped into eleven sections of *Russula* according to the taxonomic systems of Moser (1983) and Singer (1975); The results were represented below in detail.

Russula Per. ex S.F. Gray

Persoon, Obs. Myc. 1:100, 1976

S.F. Gray, Nat. Arr. Brit. Pl. 1:618, 1821

Latex absent; fruiting body hard-fleshed or fragile because of heteromorous structure with internal pockets of sphaerocysts in the half nearer the edge; epicuticle of ten± brightly colored; spore powder white to ochre-yellow and spores with warty to ridged or net-like amyloid, external ornamentation, rounded to broad ellipsoidal.

1. Mostly large, robust types. Cap 5-15(20) cm and more, whitish and remaining so or

- discoloring dirty brown or blackish, some types reddening when damaged. Flesh hard, Fragile. Cap skin not very distinct 1 *Compactae* Fr.
- 1*. Cap with different, usually brighter colors or smaller, less hard-fleshed types..... 2
2. (1) Stipe brown, grey-brown, yellow-brown, ochre-yellow. Cap margin \pm heavily striate, sulcate, surface greasy or shiny, not pruinose. Mild or sharp, often with strong, pleasant to unpleasant smell 2 *Ingratae* Quel.
- 2*. Not with these characteristics 3
3. (2) Mild tasting (or at most very slightly sharpish, possibly bitter) 4
- 3*. Sharp-tasting types 9
4. (3) Cap with red, dull red, violet to blue colores (without green), matt, pruinose pigment often cloudy. Mild or bitter. 5 *Lepidinae* and *Liaceinae*
- 4*. Cap not at the same time with these colors and pruinose and mild..... 5
5. (4) Cap green, violaceous, bluish, greyish, flesh-reddish or brown, not pruinose. Spore powder A-D. Mild to slightly acid. Without smell of trimethylamine, herrings *etc.* 3 *Heterophyllae* p. p.
- 5*. With other characteristics..... 6
6. (5) Cap with purple, violet to green or yellow colores. Stipe usually purple, sometimes also whitish. Smell of trimethylamine (herrings). Flesh not green with FeSO_4 (10%). ... 4 *Heterophyllae* Group *Amoena*
- 6*. Without these characteristics. 7
7. (6) Flesh reacting green with FeSO_4 (10%), Smell at least of ripe fruiting body of trimethylamine, herrings *etc.* 7 *Xerampelinae*
- 7*. With other characteristics. Spore powder deep cream, ochre to yellow. 8
8. (7) Smaller to medium-sized, fragile types.

- Spore powder ochre (F-H).
..... 6 *Chamaeleontinae*
- 8*. Cap orange to brick-colored, orange-pink (possibly also red with copper tone) or lamellae lemon-yellow. Flesh not turning grey..... 8 *Laetinae*
9. (3) Cap cherry-red, carmine to dull wine-red, wine-violet. Spore powder white to light cream..... 10
- 9*. Sharp tasting with cream to light ochre soore (C-E). 11 *Sanguinae*
10. (9) Cap cherry-red to bright carmine. Spore powder white..... 9 *Emeticinae*
- 10*. Cap dull red, wine violet. Spore powder whitish to light cream (A-C).
..... 10 *Atropuranae*

1. *Compactae* Fr.

1. *Russula delica* Fr., *Epicr.* p. 350, 1838. 푸른주름무당버섯
Hong and Chung (1977): 35, pl. 5, f. 1.
Ill.: Imaz. & Hongo (1957): 92, pl. 41, f. 232;
Ito (1959): 452, f. 193; Shaffer (1964):
218, f. 15; Rayner (1970): 81; Moser
(1983): 430.

Pileus 5~10 cm broad; dry; mat; somewhat roughened by fine innate fibrils; whitish at first, soon stained sordid reddish. Lamellae thick and distant; often with bluish green flushes; intervenose.

Stipe 1~2.5 cm thick, apex with bluish green tints.

Spores $7.5\sim 11\times 7\sim 9.5\ \mu\text{m}$, usually elliptic to broadly elliptic. Ornamentation $0.4\sim 1.2\ \mu\text{m}$ high, united in ridges or clusters, or connected by fine lines; usually forming a broken to nearly complete reticulum.

Basidia $56\sim 64\times 10\sim 12\ \mu\text{m}$; clavate; 4-spored. Pleuropseudocystidia $53\sim 93\times 6.5\sim 12\ \mu\text{m}$; occasionally clavate, usually clavate-fusiform; sometimes capitate or submoniliform near the apex, with \pm refractive, yellowish contents; projecting

to 27 μm beyond the basidioles; abundant. Cheilopseudocystidia; abundant.

Pileus cuticle 133~200 μm thick; lacking a gelatinous matrix.

Observation; Hong and Chung(1977) described this species that lamellae was somewhat dense, white, and spore 7.5~9.5 \times 6.5~8 μm .

2. *Russula delica* var. *glaucophylla* Quel., *C.R. Ass. Franc. Av. Sci.* 30(2):495, pl. 3, f. 7, 1902. 흰 무당버섯

L. chloroides; Lee and Lee(1957): 4; *R. delica* v. *glaucophylla*; Kim, Park and Kim(1977): 4.

Ill.: Ito(1959): 453; Shaffer(1964): 229.

Observation: This mushroom resembles *R. delica*, but it differs from more large fruiting body and dense lamellae than the latter. Also with bluish green flushes of lamellae, spore 8.1~10.8 μm , globose or subglobose; Flesh taste mild but lamellae bitter.

3. *Russula pseudodelica* J. Lange, *Dansk Bot. Ark.* 4(12):27, 1926. 흰무당버섯아재비

Lee, J.Y.(1975): 28; Kim, Park and Kim(1977): 4; Cho and Lee(1979): 3.

Ill.: Ito(1959): 454; Shaffer(1964): 227, f. 19; Imaz. & Hongo(1965): 103, pl. 32, f. 193; Rayner(1970): 81; Moser(1983): 431.

4. *Russula nigricans*(Bull.) ex Fr., *Epicr.* 350, 1838. 절구버섯

Lee and Lee(1958): 11; Lim and Kim(1972): 136; Kim, Park and Kim(1977): 4.

Ill.: Imaz. & Hongo(1957): 92, pl. 41, f. 233; Shaffer(1962): 265; Rayner(1970): 82; Rinaldi and Tyndalo(1974): 145; Phillips(1981): 92; Moser(1983): 431.

5. *Russula adusta*(Pers. ex Fr.) Fries, *Epicr.* 350, 1838. Kim, Park and Kim(1977): 7, pl. B. 흙갈색 무당버섯

Ill.: Shaffer(1962): 278, pl. 14, f. 10; Rinaldi and Tyndalo(1974): 146; Phillips(1981):

91; Moser(1983): 431.

6. *Russula densifolia*(Secr.) Gill., *Hymen.* 231. (1874). Lim and Kim(1972): 15; Kim, Park and Kim(1977): 4; Cho and Lee(1979): 3.

애기무당버섯

Ill.: Imaz. & Hongo(1957): 92, pl. 141, f. 234; Shaffer(1962): 270, pl. 11, figs. 8a, 17; Rayner(1970): 82; Rinaldi and Tyndalo(1974): 145; Phillips(1981): 92; Moser(1983): 431.

7. *Russula subnigricans* Hongo, *Journ. Jap. Bot.* 30(3):78, f. 3 1955. 절구버섯아재비(신칭)

Ill.: Hongo(1955): 78, f. 3; Ito(1959): 457; Shaffer(1962): 261, figs. 3, 14; Imaz. & Hongo(1965): 103, pl. 32, f. 194.

Pileus 5~15cm broad or more; with margin incurved at first becoming convex, then plane and depressed, at length infundibuliform; dry; minutely velvety; with cuticle scarcely separable and margin not striate; fuliginous-umber, The margin slightly paler. Trama thick; compact; white, when broken becoming reddish, but not blackening; with odor and taste none.

Lamellae moderately broad, 6~9mm broad; rather thick; adnate or with a slightly decurrent tooth; distant; scarcely forked; sometimes more or less intervenose; brittle; pale cream, when bruised becoming reddish.

Stipe 3~6cm long, 1~2.5cm thick; equal or attenuated downward; indistinctly rugosostrate; solid or stuffed; paler than pileus, whitish at base.

Spores 6~9 \times 6.5~8 μm ; usually broadly ellipsoid to subglobose, occasionally ovoid or globose. Ornamentation 0.1 μm eighth or less; of warts which are usually connected by fine to moderately heavy lines, the whole forming a broken to nearly complete reticulum. Suprahilar disc a plage.

Bacidia 4-spored, 38~50 \times 8~9.5 μm ; cheilo- and pleurocystidia similar, scattered, lanceolate

basidiform of narrowly fusiform, thin-walled, 53~88×9.5~12.5 μm; gill-trama intermixed.

Habitat; Gregarious or scattered, on the ground in broadleaved forests.

Distribution; Korea (Daejeon)

Observation; In *R. subnigricans* the spore ornamentation characteristic of *R. albonigra* is combined with the distant lamellae and color change to red of *R. nigricans*. This fact makes it tempting to speculate on the evolutionary relationship among the three species. At a glance, fugiginous-umber and velvety cap of this mushroom resembles *L. gerardii*.

8. *Russula albonigra* (Kromb.) Fries, *Mon. Hym-en. Suec.* 2: 324 1863. 검은무당버섯 (신칭)

Ill.: Chiu (1945): 41, f. 18; Shaffer (1962): 257, pls. 7~8, figs. 2, 13; Rayner (1970): 83; Rinaldi and Tyndalo (1974): 146; Phillips (1981): 91; Moser (1983): 431.

Pileus 6~10 cm broad or more; when young broadly convex with incurved margin, becoming plano-depressed, finally infundibuliform; subviscid to merely moist at first, soon dry; mat; glabrous, with cuticle not or scarcely separable and margin not striate; when young whitish overall, gradually becoming brown to fuscous or black, when bruised usually browning or blackening directly. Trama thick, 12~20 mm thick; hard, white, when cut soon becoming fuscous or black; with odor slight or none and taste mild.

Lamellae 4~9 mm broad; acute in front; adnate to decurrent; close to subcrowded; somewhat forked at stipe and outward; intervenose or not; white to pale yellow, when bruised becoming blackish or black. Lamellulae numerous.

Stipe 2.5~10 cm long, 1.5~3 cm thick; equal; glabrous to puberulent; unpolished; solid becoming stuffed; white, in age and/or when bruised darkening like pileus.

Color reactions (trama): FeSO₄, olive or green;

SV,

Spores white in deposit; 7.5~10×7~8 μm; usually ellipsoid. Ornamentation usually 0.2 μm high or less, forming a broken to nearly complete reticulum with fine lines. Suprahilar disc a plage.

Basidia 43~70×7~11 μm; clavate; usually 4-spored. Pleurocystidia 43~106×4~12 μm; subcylindrical to fusoid, with apices rounded to acute; filled with refractive contents or partially empty; abundant, but sometimes inconspicuous.

Cheilocystidia 37~93×4~11 μm; of same type as the pleurocystidia.

Habitat; solitary to gregarious in deciduous and mixed forests.

Observation: The diagnostic characteristics of *R. albonigra* is the color change directly to blackish and the low spore ornamentation.

9. *Russula compacta* Prost et Pk., apud Peck, *Ann. Rep. N.Y. stat. Mus.* 32:32 1880. 담갈색무당버섯 (신칭)

Ill.: Singer (1943): 143; *Graham* (1944): 205, pl. 22, f. 29. Ito (1959): 456; Krieger (1967): 433; Hongo (1968): 51, f. 22 (5-6); Lincoff (1981): 699, pl. 286.

Pileus 7.5 cm or more broad, convex, then plane and depressed, at length somewhat infundibuliform; surface dry, glabrous or more or less granuloso-squamulose, especially in the center; cinnamon to cinnamon buff; margin incurved when young. Flesh thick, firm, white, becoming slowly red-brownish, on exposure to the air; taste mild; odor unpleasant, of herring, and becoming more so on drying.

Lamellae almost free, crowded, often forked, rather narrow (±4 mm), white, staining brownish where bruised.

Stipe 4.5 cm or more long, 1.7 cm thick, equal, firm; slightly wrinkled, stuffed; white, staining brownish

Spores white in mass, subglobose, 7~10×6.5

~8.3 μ m ornamentation 0.3~0.5 μ m high, forming a finely partial reticulum.

Basidia 40~53 \times 9.5~1.2 μ m, 4-spored; cheilo- and pleurocystia, 46~68 \times 6~8 μ m, lanceolate mucronate, abundant.

Chemical reactions; FeSO₄, immediately green; SV, becoming chocolate brown (normal reaction).

Habitat: In mixed woods, on fairly humid places, mostly in summer, rather frequent.

Distribution: Korea (Mt. Gyeryong), Japan, North America.

Observation: Easily recognizable by the cinnamonaceous color of the cap, the brownish discoloration when cut or bruised and by the strong odor on drying.

2. *Ingratae* Quel.

10. *Russula foetens* Pers. ex Fries, *Epicr.* 359 1838. 예기갈때기무당버섯

Lee, Y.W. (1959): 23; Lim and Kim (1972): 15; Kim, Park and Kim (1977): 5.

Ill.: Imaz. & Hongo (1957): 93, pl. 42, f. 237; Rayner (1970): 85; Phillips (1981): 92; Moser (1983): 442, 443

11. *Russula laurocerasi* Melzer, *Cinopsis Ceskoslou Houby* 243 1920. 버찌무당버섯

Hong and Chung (1977): 36; Kim, Park and Kim (1977): 8.

Ill.: Imaz. & Hongo (1965): 106, pl. 33, f. 196; Rayner (1970): 85; Shaffer (1972): 1039, figs. 34-37; Lincoff (1981): 704, pl. 306; Phillips (1981): 92; Moser (1983): 432.

12. *Russula senecis* Imai, Jour. Facul. Agr. Hokkaido Imp. Univ. 43: 334, pl. 5, f. 7. 1938. 흙무당버섯

Lim, J.H. (1968): 10; Lim and Kim (1972): 15; Kim, Park, and Kim (1977): 5.

Ill.: Ito (1959): 461, f. 197; Imaz. & Hongo (1957): 93, pl. 42, fig. 238.

13. *Russula sororia* Fries, *Epicr. Myc.* 359. 1838. 회갈색 무당버섯

Lee, J.Y. (1975): 28; Kim, Park and Kim (1977): 5.

Ill.: Imaz. & Hongo (1957): 93, pl. 42, f. 241; Ito (1959): 461, f. 196; Rayner (1970): 86; Rinaldi and Tyndalo (1974): 164; Phillips (1981): 92; Moser (1983): 433.

14. *Russula ochroleuca* Pers. ex Fries, *Epicr. Myc.* 358. 1838. 쪼개무당버섯

Lee and Lee (1957): 9; Lee, J.Y. (1957): 5; Lim and Kim (1972): 15; Kim, Park and Kim (1977): 5.

Ill.: Ito (1959): 462, f. 198; Rayner (1970): 87; Rinaldi and Tyndalo (1974): 162; Phillips (1981): 94; Moser (1983): 433.

3. *Heterophyllae* p.p.

15. *Russula virescens* (Schaeffer ex Secretan) Fries, *Epicr. Myc.* 355. 1838. 기와버섯

Uyeki (1936): 3; Lee and Lee (1958): 10; Kim, Park and Kim (1977): 6.

Ill.: Imaz. & Hongo (1957): 94, pl. 43, f. 242; Rayner (1970): 84; Shaffer (1970): 236, f. 7-11; Rinaldi and Tyndalo (1974): 149; Phillips (1981): 94; Moser (1983): 434.

16. *Russula crustosa* Pk., *Ann. Rep. N.Y. State Mus.* 39: 41. 1887. 기와무당버섯

Lim, J.H. (1968): 10; Lim and Kim (1972): 15; Kim, Park and Kim (1977): 6.

Ill.: Graham (1944): 206, pl. 22, f. 19; Imaz. & Hongo (1957): 94, pl. 43, f. 243; Krieger (1967): 434; Shaffer (1970): 233, figs. 1-6; Lincoff (1981): 700, pl. 356.

17. *Russula vesca* Fr. 조각무당버섯

Kim, Kim, Park and Hongo (1975): 32; Kim, Park and Kim (1977): 5.

Ill.: Imaz. & Hongo (1965): 106, pl. 33, f. 197; Rayner (1970): 85; Rinaldi and Tyndalo (1974): 151; Moser (1983): 435; Phillips (1981): 97.

18. *Russula cyanoxantha* (schaeff.) Fr., *Mon. Hy-*

- men. Suec.* 2: 194. 1863. 청머루무당버섯
 Lee, J.Y.(1976): 266; Kim, Park and Kim
 (1977): 5.
 Ill.: Imaz. & Hongo(1965): 108, pl. 34, f.
 200; Rayner(1970): 84; Rinaldi and
 Tyndalo(1974): 148; Moser(1983): 434;
 Phillips(1981): 97
 Pileus 5~15 cm wide, at first globose, someti-
 mes one but usually a mixture of colors, mostly
 dullish lilac, purplish, vinaceous, olivaceous,
 greenish or brownish; flesh, firm to hard; greasy
 when moist; with radial anastomosing veins,
 half peeling.
 Lamellae whitish or very pale cream, rather
 narrow, flexible forked to various degrees.
 Stipe 5~10×1.5~3 cm, sometimes flushed
 purplish; firm; mild taste.
 Spore powder white, 7~9×6~7 μm, broadly
 ellipsoidal; warts up to 0.6 μm high, rather
 broad; dermatocystidia scattered short, narrow
 2~4 μm, cylindrical, appendiculate.
 Chemical reactions; SV, distinctly violaceous
 purple.
 Habitat; under the deciduous trees, very com-
 mon.
19. *Russula cyanoxantha* var. *peltereaui* Singer
 푸른무당버섯(신청)
 Ill.: Rayner(1970): 84; Rinaldi and Tyndalo
 (1974): 146; Phillips(1981): 97; Moser
 (1983): 434.
 Observation: var. *peltereaui* differs only in
 Pileus completely green from *R. cyanoxantha*.
4. *Heterophyllae* p.p.; Group *Amoena*
20. *Russula amoena* Quel., *Champ. Jura. Vog.*
Suppl. 10:668, pl. 8, f. 10. 1880. 가지무
 당버섯
R. punctata(Gill.) Maire: Lee and Lee(1957):
 8; Lim and Kim(1972): 15; Kim, Park
 and Kim(1972): 15; Kim, Park and Kim
 (1977): 6.
 Ill.: Hongo(1967): Mem. Shiga Univ. 17:93,
 f. 18(5~9); Rayner(1970): 84; Rinaldi
 and Tyndalo(1974): 146; Moser(1983):
 436.
21. *Russula violeipes* Quel. 자춧빛무당버섯
 Kim, Kim, Park and Hongo(1975): 32; Kim,
 Park and Kim(1977): 5.
 Ill.: Rayner(1970): 84; Phillips(1981): 94;
 Moser (1983): 436.
22. *Russula flavida* Frost et Peck, Rep. N.Y.
State Mus. 32:32 1880. 노랑무당버섯
 Kim, Kim, Park and Hongo(1975): 32; Hong
 and Chung(1977): 36; Kim, Park and Kim
 (1977): 6.
 Ill.: Chiu(1945): 44, f. 23; Ito(1959): 467,
 f. 200; Imaz. & Hongo(1957): 93, pl.
 42, f. 240.
5. *Lepidinae* and *Lilacinae*
23. *Russula lepida* Fries, *Epcr. Myc.* 355.1838.
 줄각무당버
 Lee, J.Y.(1973): 53; Kim, Park and Kim
 (1977): 6.
 Lee, J.Y.(1973): 53; Kim, Park and Kim
 (1977): 6
 Ill.: Chiu(1945): 45, f. 25; Imaz. & Hongo
 (1957): 92, pl. 41, f. 236; Rayner(1970):
 83; Phillips(1981): 109; Ito(1959): 469.
24. *Russula lilacea* Quel., *Champ. Jura. Vog.*
Suppl. 4: pl. 2, f. 8. 1876. 연보라무당버
 섯
 Hong and Chung(1977): 36.
 Ill.: Ito(1959): 468, f. 201; Imaz. & Hongo
 (1965): 107, pl. 33, f. 198; Rayner
 (1970): 93; Moser(1983): 437.
25. *Russula bella* Hongo, Mem. Shiga Univ.
 18: 50, f. 22(1~4). 1968. 수월무당버섯
 Lee, J.Y.(1975): 28.
 Pileus(1.7) 2~4.5 cm wide, convex, then
 expanded and depressed; surface viscid when
 wet, granuloso-pruinose; almost peach red, con-
 tains jasper red to scarlet red or coral red to
 scarlet; margin blunt, smooth or in aæ shortly

sulcate; flesh fragile, white, unchanging; somewhat thick in disc, in margin thin; taste mild, odor pleasant.

Lamellae slightly attenuate; nearly free, close to subdistant, little forked; intervenose; white then creameous; edges sometimes rose-colored; 3-4 mm wide.

Stipe (1.5) 2-4 cm long, (4) 5-7 mm thick; equal or commonly attenuate at base, slightly rugoso-striate, somewhat pruinose; mostly rose-colored, white in rare; stuffed then hollow at maturity.

Spore powder pale cream; spores ovoid to subglobose 6.5-7.5 × 5.5-6 μm, warts and ridges forming a partial reticulum.

Basidia 4-sporod, 25-37 × 9-9.5 μm (or 45-50 × 9-10.5 μm).

Cheilo cystidia; 37-65 × 5.5-7 μm, narrowly fusoidventricose, acute an apex, abundant; pleurocystidia scattered, 44-55 × 5.5-7 μm, pilocystidia 44-80 × 5.3-8 μm.

Habitat: Solitary or gregarious on the ground in forests, by roadsides or in gardens, especially under *Pinus* and *Quercus*, very common, from early summer to autumn.

Observation: Characterized by the beautiful scarlet color the minutely pruinose surface of the cap, the creameous gills and the pleasant fruity smell like that of *R. violeipes* Quel

Very close to *R. auoena* Quel, *R. violeipes* Quel etc. etc., differing chiefly in the color cap.

6 *Chamaeleontinae*

26. *Russula chamaeleontina* Fr., 변덕장이 작은 무당버섯

Kim, Kim, Choi and Shim(1976): 19.

Ill.: Graham(1944):213, pl. 22, f.22; Rinaldi and Tyndalo(1974): 146; Moser(1983): 438.

7 *Xerampelinae*

27. *Russula xerampelina* (Secr.) Fr., *Epicr. Myc.* 356. 1838. 포도무당버섯

Kim, Kim, Park and Hongo(1975):32; Kim, Kim, Choi and Shim(1976):19; Kim, Park and Kim(1977): 6.

Ill.: Hongo(1956):254; Imaz.& Hongo(1957): 94, pl. 43, 246; Rayner(1970):95; Rinaldi and Tyndalo(1974): 152; Phillips(1981): 104; Moser(1983):440.

8 *Laetinae*

28. *Russula aurata* (With.) Fr., *Epicr. Myc.* 360. 1838. 황금무버섯

Kim, Y.S. et al: A mem. Res. Work (title translated); Ins. Agr. Sci., 1979.

Ill.: Imaz. & Hongo(1965):108, pl. 34, f. 201; Rayner(1970): 97; Moser(1983):443.

9 *Emeticinae*

29. *Russula emetica* (Schaeff. ex Fr.) Pers. ex S.F. Gray, *Nat. Arr. Brit. Pl.*: 618. 1821. 무당버섯

Uyeki(1936):2; Lee and Lee(1957): 9; Kim, Park and Kim(1977): 7.

Ill.: Imaz. & Hongo(1965):108, pl. 34, f. 199; Rayner(1970): 87; Shaffer(1975): 227, pl. 51, figs. 9-17; Lincoff(1981): 701, pl. 328; Phillips(1981): 99; Moser(1983): 444.

10 *Atropurpurinae*

30. *Russula fragilis* (Pers. ex Fr.) Fr., *Epicr. Myc.* 359. 1838. 애기무당버섯

Lee and Lee(1958): 11; Kim, Park and Kim (1977): 7.

Ill.: Ito(1959): 473, f. 20; Rayner(1970): 88; Shaffer(1975): 223; Lincoff(1981): 702, pl. 343; Phillips(1981): 99; Moser(1983): 446.

31. *Russula fragilis f. nivea* (Pers. ex Cooke) J. Schaeff., *Ann. Myc.* 31: 461. 1933. 흰애기 무당버섯

Lee and Lee(1957): 8; Lim and Kim(1972): 15; Kim Park and Kim(1977): 7.

Ill.: Ito(1959):474; Rayner(1970): 89.

11 *Sanguiniae*

32. *Russula sanguinea* Fr., *Epicr. Myc.* 351.
1838. 혈색무당버섯
Kim, Park and Kim(1977): 8, pl. A.
Ill.: Imaz. & Hongo(1957): 94, pl. 43, f. 245;
Rayner(1970): 90; Charles and Macadam
(1973): 191; Phillips(1981): 103; Moser
(1983): 448.
33. *Russula pulchella* Borszczow 색바른무당버섯
Shin, Bok and Kim(1984): 448.
Ill.: Rayner(1970): 92; Rinaldi and Tyndalo
(1974): 158; Phillips(1981): 104; Moser
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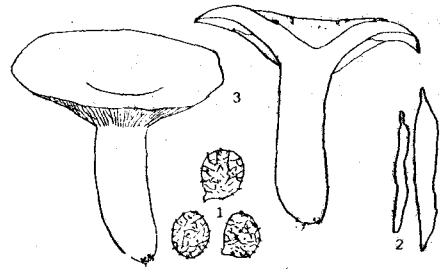


Fig. 1. *Russula compacta*: 1) spores; 2) cheilocystidia; 3) carpophore



Fig. 2. *R. albonigra*: 4) spores

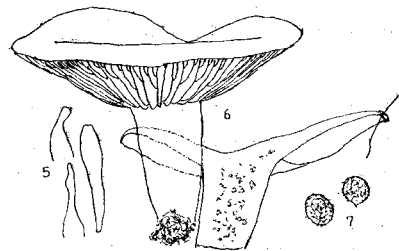


Fig. 3. *R. subnigricans*: 5) cheilocystidia; 6) carpophores 7) spores