

## Taxonomic Study on Korean *Stereum*

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### 한국산 꽃구름버섯속의 분류학적 연구

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**ABSTRACT:** The genus *Stereum* is consisted of species having smooth, binucleate amyloid spores, pseudocystidia and dimitic basidiocarps without clamps. There are five recorded species of *Stereum* in Korea. Through the specimen examination of Seoul National University Fungal Collection, five more species of *Stereum*, *S. subtomentosum*, *S. peculiare*, *S. sanguinolentum*, *S. striatum* and *S. complicatum*, were confirmed as unrecorded species to Korea. They are registered here with Korean names as well as English descriptions and a key to Korean *Stereum* species is attached together.

**KEYWORDS:** Pseudocystidia, *Stereum*, Unrecorded species

*Stereum* is a genus of white-rotting fungi which play an important role in degradation of wood materials and thus take part in carbon recycling of the forest ecosystem. Most of *Stereum* species cause white rot on hardwoods but certain species like *S. gausapatum*, *S. striatum* and *S. sanguinolentum* have various degrees of substratum affinities and are specialized for the growth on coniferous trees (Chamuris, 1988).

Fries adopted the generic concept of *Stereum* Hill: Per. in 1838 as an infrageneric division of *Thelephora*. *Stereum* in that time included stipitate, pileate, effuso-reflexed and resupinate forms and such Fries' system had been widely used by the early twentieth century. Between 1955 and 1968, the concept of *Stereum* started to become increasingly narrow. Lentz (1955), Boidin (1958) and Pouzar (1959) segregated various groups from the species of *Stereum*, leaving *Stereum* as a smaller and more homogeneous group. Stipitate forms were excluded from *Stereum* by Lentz (1955). And Boidin (1958) reported extensive studies on cultural and morphological characters, restricting *Stereum* to the species with smooth and binucleate amyloid spores, dimitic basidiocarps without clamps, pseudocystidia, and with multiple clamps in culture.

In Korea, five *Stereum* species have been reported until now. Four species of them are *S. gausapatum* (흰테꽃구름버섯), *S. hirsutum* (꽃구름버섯), *S. ostrea* (갈색꽃구름버섯) and *S. ochraceo-flavum* (배착꽃구름버섯) (Jung, 1996).

The last one is *S. spectabile* (너털꽃구름버섯, 개칭) which used to be grouped in *Xylobolus* in Korea, but Boidin (1958) and Chamuris (1985, 1988) grouped it into *Stereum* for reasons of cultural characters.

In Seoul National University Fungal Collection (SFC), there are some stereoid specimens collected during the period from 1965 to 1998. Through the examination of SFC specimens, five species of *Stereum*, *S. subtomentosum*, *S. peculiare*, *S. sanguinolentum*, *S. striatum* and *S. complicatum*, were confirmed as unrecorded species to Korea and are registered here with Korean names and English descriptions, and a key to the species of Korean *Stereum* is provided together.

### *Stereum* 꽃구름버섯속

*Stereum subtomentosum* Pouzar, *Česká Mykol.* 18: 147, 1964 갈색털꽃구름버섯 (신칭)

Basidiocarp annual, sometimes perennial, pileate, coriaceous; pileus dimidiate, flabelliform to semicircular, often narrowly and laterally attached, applanate to undulate, resembling *S. ostrea*, protruding up to 5 cm; upper surface matted-tomentose, entirely covered with tomentum or with a few narrow glabrous zones, occasionally hirsute, grayish to gray buff or ochraceous, later greenish from algae; margin lighter to ochraceous; hymenial surface even, tuberculate or undulate, slightly radially wrinkled, with concentric ridges, light beige to ochraceous, light yellow at margin, bruising yellow when fresh; context cream to

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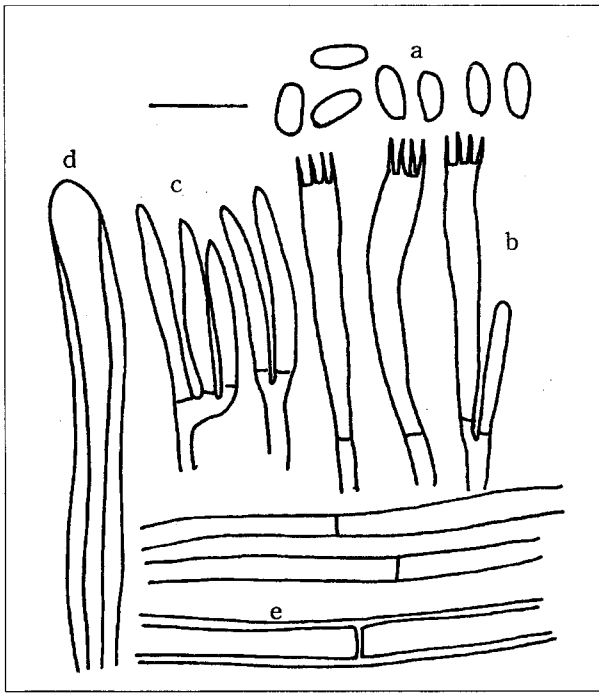


Fig. 1. *Stereum subtomentosum* 갈색털꽃구름버섯 (신칭).  
a) basidiospores, b) basidia, c) hyphidia, d) pseudocystidia,  
e) hyphae (bar = 10  $\mu$ m).

ochraceous, 0.3~0.8 mm thick in section, reddish brown at cutis.

Hyphal system monomitic, thick-walled, rounded or with a small point at tips, 3~7  $\mu$ m diam; pseudocystidia cylindrical to subcylindrical, 5~7  $\mu$ m diam, generally 1.5~3  $\mu$ m thick at base, apically thin-walled; hyphidia mostly acuminate, sometimes cylindrical, 16~25 $\times$ 2~3  $\mu$ m, thin-walled; basidia narrowly clavate to subcylindrical, with 4 sterigmata, without a basal clamp, 30~35 $\times$ 4  $\mu$ m; basidiospores ellipsoid to cylindrical, hyaline, 5~6.3 $\times$ 2.2~2.8  $\mu$ m, smooth, thin-walled, amyloid.

**Habitat and distribution:** On dead wood of various broad-leaved trees, such as *Alnus*, *Salix*, *Fagus*, etc. Widespread in Korea throughout the year.

**Remarks:** *Stereum subtomentosum* is easy to recognize in the field because of its similar appearance to that of *S. ostrea* which has been reported to occur commonly in Korea until recently. However, *S. ostrea* has a tropical or subtropical distribution and is separated by its pseudoacanthohyphidia from *S. subtomentosum* (Eriksson *et al.*, 1984), so it is mostly probable that Korean *S. ostrea* could be a form of *S. subtomentosum*.

**Specimens:** Sobaeg-san, Gyunggangbuk-do, SFC 970508-25; Baegdang-sa, Gangweon-do, SFC 971030-11; Soyo-san, Dongducheon, Gyunggi-do, SFC 980218-9; Bughan-san, Seoul, SFC 980527-3; Baemsa-gol, Jiri-san, Jeonrabug-do, SFC 980531-10.

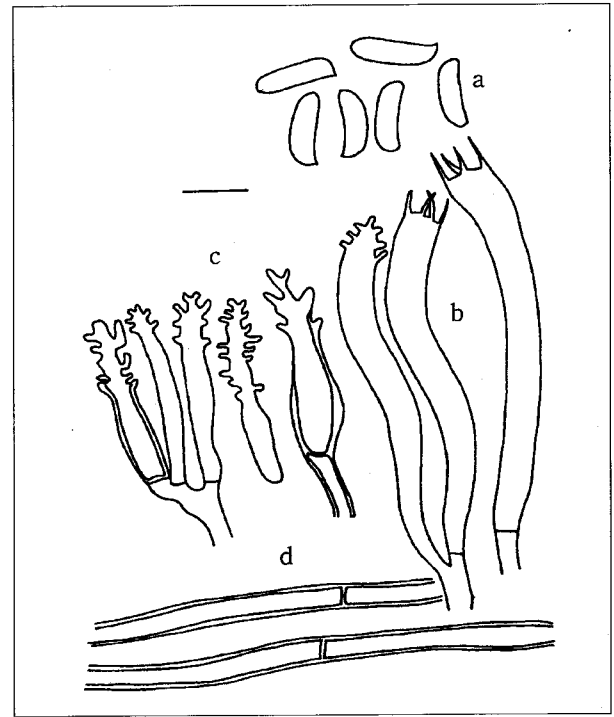


Fig. 2. *Stereum peculiare* 꺾질꽃구름버섯 (신칭).  
a) basidiospores, b) basidia, c) acanthohyphidia, d) hyphae  
(bar = 10  $\mu$ m).

***Stereum peculiare* Boidin, Parmasto et Dhingra, *Per-soonia* 10(3): 311, 1979 꺾질꽃구름버섯 (신칭)**

Basidiocarp annual, occasionally perennial, resupinate to effuso-reflexed, coriaceous, somewhat brittle when dry; pileus narrow, laterally extended, up to 4 mm protruding; upper surface white matted-tomentose at the point of attachment, appressed-hirsute with a strong zonation toward the outer part, zonate with alternating thin bands of reddish brown and grayish white color; hymenial surface uneven, tuberculate, with scattered irregular fine teeth, often finely to deeply cracked when dry; margin smooth, brown to pale brown.

Hyphal system monomitic, simple-septate, 3~5  $\mu$ m thick; acanthohyphidia mostly cylindrical, thin-walled, with numerous cylindrical prongs along the sides, 4~6  $\mu$ m diam; basidia rarely seen, narrowly clavate to subcylindrical, with 4 sterigmata, without a basal clamp, 60~67 $\times$ 6.2~7.5  $\mu$ m; basidiospores ellipsoid to cylindrical, hyaline, 11.4~12.5 $\times$ 3.4~4  $\mu$ m, smooth, thin-walled, amyloid.

**Habitat and distribution:** Usually on dead, corticate stumps, trunks and large limbs of *Quercus* spp. Widespread in Korea.

**Remark:** It is rather easy to recognize this *Stereum* in *Quercus* forests because of its scattered irregular fine teeth and brown color of resupinate hymenial surface finely to deeply cracked when dry, and acanthohyphidia are mi-

microscopically an important character for the identification of this species (Boidin *et al.*, 1979).

**Specimen:** Bughan-san, Seoul, SFC 970912-7; Chiag-san, Weonju, Gangweon-do, SFC 971215-13; Dosanseoweon, Andong, Gyung-sangbug-do, SFC 980119-5; Bongcheon-san, Hajeom-myeon, Ganghwa-do, Incheon, SFC 980129-2; Naega-myeon, Ganghwa-do, Incheon, SFC 980201-6; Soyo-san, Dongducheon, Gyunggi-do, SFC 980218-13.

*Stereum sanguinolentum* (Alb. et Schw.: Fr.) Fr., *Epicr. syst. mycol.*, p. 549, 1838 유혈꽃구름버섯 (신칭)

Basidiocarp annual, resupinate, effuso-reflexed or umbonate-sessile, and subcupulate, confluent, imbricate on vertical substrata, coriaceous; pileus dimidiate, broadly to narrowly attached, becoming laterally extended, up to 1 cm in radius; upper surface matted-tomentose, with strigose-hirsute zones, becoming nearly glabrous in age, with tomentum often worn in thin concentric bands, furrowed to sulcate, grayish orange, brownish orange, blackish brown when dried; hymenial surface even, rarely tuberculate, often slightly rugose, cracking to reveal paler context, light brown, reddish brown, grayish brown or gray with violaceous tinges, bleeding or bruising red when fresh, white at margin; context paler, 0.2–0.6 mm thick in section, simple, occasionally forming two strata, brown at cutis.

Hyphal system monomitic, slightly thick- to thick-walled, with brown oily contents, usually conspicuous in vertical section, 4–8  $\mu\text{m}$  diam; pseudocystidia cylindrical to sub-

cylindrical, often flexuous, slightly thick- to thick-walled at base, apically thin-walled, with brown oily contents, derived from conducting hyphae or directly from undifferentiated hyphae, 5–10  $\mu\text{m}$  diam; pseudoacanthohyphidia cylindrical or acuminate, thin-walled, 23–34  $\times$  2–4  $\mu\text{m}$ ; basidia subcylindrical to cylindrical, with 4 sterigmata, without a basal clamp, 28–37  $\times$  4–6  $\mu\text{m}$ ; basidiospores ellipsoid to cylindrical, hyaline, 5–7.5  $\times$  2–3.5  $\mu\text{m}$ , smooth, thin-walled, amyloid.

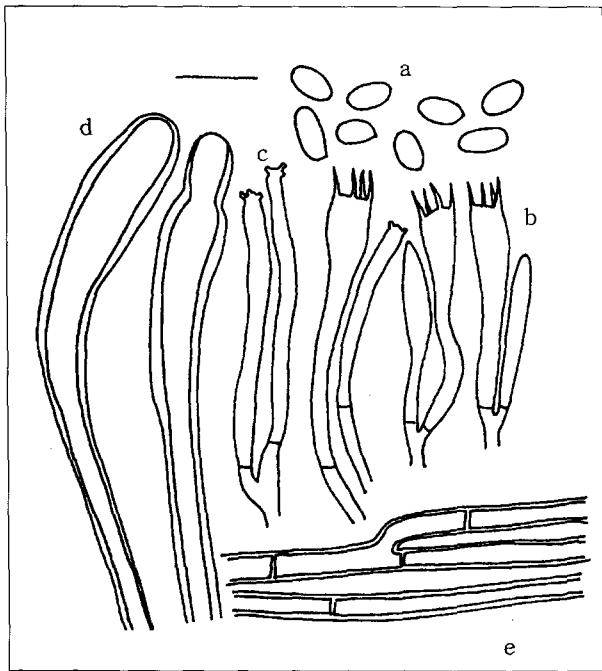
**Habitat and distribution:** On the branch of a fallen *Pinus thunbergii*.

**Remark:** This species is the only *Stereum* which normally inhabits coniferous substrata. This character, along with the tendency to bruise red when fresh, and the presence of pseudoacanthohyphidia and colored conducting hyphae make this species rather easy to identify.

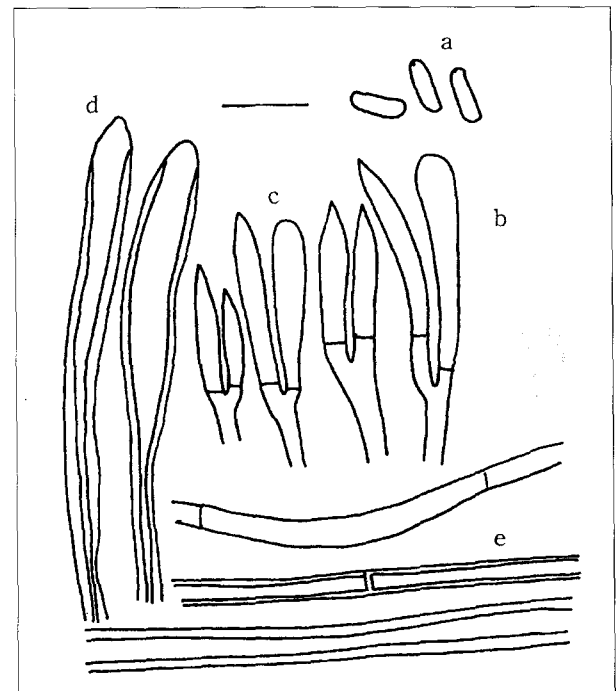
**Specimen:** Ui-do, Docho-myeon, Shinan-gun, Jeonranam-do, SFC 980816-9.

*Stereum striatum* (Fr.: Fr.) Fr., *Epicr. syst. mycol.*, p. 548, 1838 줄무늬꽃구름버섯 (신칭)

Basidiocarp annual, effuso-reflexed to sessile, confluent, coriaceous, somewhat brittle when dry; pileus dimidiate to flabelliform, up to 1.5–3 cm in radius, occasionally larger; upper surface matted-tomentose with woolly strigose-hirsute patches at the point of attachment, shiny, sericeous, lineate-striate, with exposed cutis, strongly zonate with thin alternating bands of light orange, grayish orange, brownish



**Fig. 3.** *Stereum sanguinolentum* 유혈꽃구름버섯 (신칭).  
a) basidiospores, b) basidia, c) pseudoacanthohyphidia, d) pseudocystidia, e) hyphae (bar = 10  $\mu\text{m}$ ).



**Fig. 4.** *Stereum striatum* 줄무늬꽃구름버섯 (신칭).  
a) basidiospores, b) basidia, c) hyphidia, d) pseudocystidia, e) hyphae (bar = 10  $\mu\text{m}$ ).

orange to brown color; hymenial surface even, sometimes radially wrinkled, light yellow to yellow, brownish orange; context subhyaline, pale yellow to yellow brown, 150~400  $\mu\text{m}$  thick in section, slightly thickening, not stratose, brown at cutis.

Hyphal system monomitic, simple-septate, hyaline, 2~4  $\mu\text{m}$  diam; conducting hyphae thick-walled, 4~8  $\mu\text{m}$  diam; pseudocystidia cylindrical to subcylindrical, thick-walled at base, apically thin-walled, 4~11  $\mu\text{m}$  diam; hyphidia acute, thin-walled, 3~4  $\mu\text{m}$  diam; basidia narrowly clavate to subcylindrical, with 4 sterigmata, without a basal clamp, 25~35  $\times$  4~5  $\mu\text{m}$ ; basidiospores ellipsoid to cylindrical, hyaline, 6.3~7  $\times$  2~2.2  $\mu\text{m}$ , smooth, thin-walled, amyloid.

**Habitat and distribution:** On the trunk of a fallen dead *Carpinus laxiflora*.

**Remark:** *Stereum striatum* is reported to be closely related with *S. ochraceo-flavum* and microscopic similarities between *S. striatum* and *S. ochraceo-flavum* led Welden (1971) to suggest that they are merely two different forms of a same species. In this study, these two species are considered separate, based on differences in the texture of the upper surface and the ecological habitats.

**Specimen:** Baegmu-dong, Jiri-san, Jeonranam-do, SFC 950831-10-2.

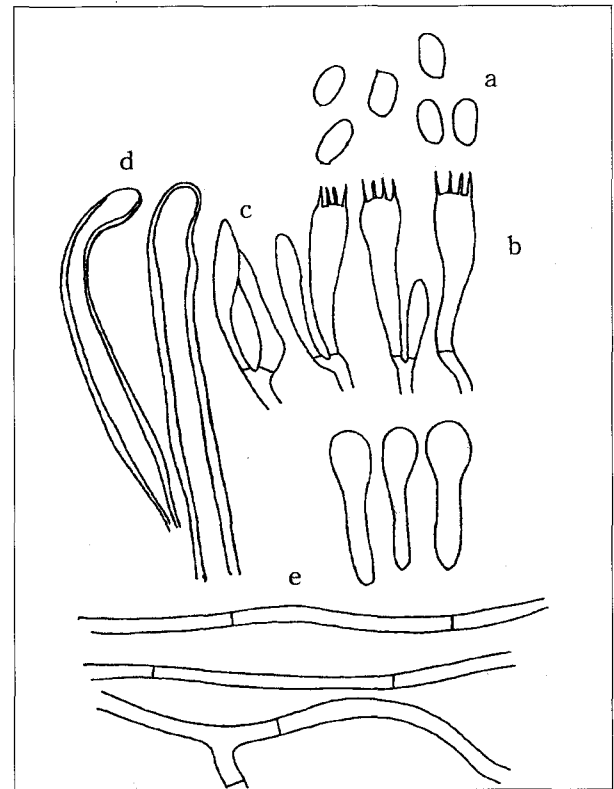
***Stereum complicatum* (Fr.: Fr.) Fr., Epicr. syst. mycol., p. 548, 1838 복합꽃구름버섯 (신칭)**

Basidiocarp annual, effuso-reflexed to sessile, sometimes umbonate, confluent, often imbricate on vertical substrata, coriaceous-papery; pileus narrowly attached, becoming laterally extended, radially plicate to complicate, thin and lacerate at margin, usually less than 2 cm in radius; upper surface matted-tomentose with a thin transient tomentum with strigose-hirsute patches at the point of attachment, zonate, gray or grayish brown at inner part, ochraceous white at outer part, buff at margin; hymenial surface even, light yellow to buff; context cream to ochraceous, 0.5~0.8 mm thick in section, thickening, brown at cutis.

Hyphal system monomitic, simple-septate, thin- to thick-walled, 2~4  $\mu\text{m}$  thick; conducting hyphae thick-walled, hyaline, 4~8  $\mu\text{m}$  diam; pseudocystidia cylindrical to subcylindrical, generally thick-walled at base, apically thin-walled, 4~7  $\mu\text{m}$  diam; hyphidia mostly cylindrical, sometimes acuminate, thin-walled, 24~27  $\times$  2~3  $\mu\text{m}$ ; basidia narrowly clavate to subcylindrical, with 4 sterigmata, without a basal clamp, 25~32  $\times$  4~6  $\mu\text{m}$ ; basidiospores ellipsoid to cylindrical, hyaline, 6.5~8  $\times$  3~3.4  $\mu\text{m}$ , smooth, thin-walled, amyloid.

**Habitat and distribution:** Near the base of a dead *Quercus acutissima*.

**Remarks:** *Stereum complicatum* is microscopically very similar to *S. hirsutum*, so they are distinguished from each



**Fig. 5.** *Stereum complicatum* 복합꽃구름버섯 (신칭).  
a) basidiospores, b) basidia, c) hyphidia, d) pseudocystidia, e) hyphae (bar = 10  $\mu\text{m}$ ).

other on the gross morphology of the tomentum, hymenium or fruitbody thickness. It is known that such a separation is often impossible because intermediate fruitbodies are frequently found. For this reason, Welden (1971) suggested that *S. complicatum* should be maintained as a member of the *S. hirsutum* complex.

**Specimen:** Naega-myeon, Ganghwa-do, Incheon, SFC 980201-4.

**Key to Korean *Stereum* species**

- 1. Hymenium with acanthohyphidia or pseudoacanthohyphidia.....2
- 1. Hymenium without acanthohyphidia or pseudoacanthohyphidia.....5
- 2. Acanthohyphidia absent; pseudoacanthohyphidia rarely present.....3
- 2. Acanthohyphidia present.....4

**Subgenus *Aculeatostereum***

- 3. Growing on conifers.....*S. sanguinolentum*
- 3. Growing on hardwoods.....*S. ostrea*

**Subgenus *Acanthostereum***

- 4. Basidiocarp effuso-reflexed to sessile; basidiospores 4.5~6  $\mu\text{m}$  long.....*S. spectabile*
- 4. Basidiocarp resupinate, effuso-reflexed; basidiospores

- 11~12.5  $\mu\text{m}$  long.....*S. peculiare*
- Subgenus *Stereum***
5. cutis absent or poorly defined; old specimens may form pale yellow zones.....6
5. brownish cutis present.....7
6. Tomentum composed of erect hairs hardwoods.....*S. ochraceo-flavum*
6. Tomentum virtually absent at maturity, composed of short, appressed hairs.....*S. striatum*
7. basidiocarp radially plicate, bruising in red; margin white to cream when fresh; gloecystidia with brown content like pseudocystidia; on *Quercus*.....*S. gausapatum*
7. not as above.....8
8. Pileus dimidiate, flabelliform; tomentum strigose-hirsute; basidiospores generally large, 6.5~8 (8.7)  $\times$  2.5~3  $\mu\text{m}$ .....*S. hirsutum*
8. Pileus dimidiate, flabelliform to semicircular, usually narrowly attached; basidiospores generally less than 7  $\mu\text{m}$  in length.....9
9. reflexed part generally less than 2 cm in radius, white-tomentose.....*S. complicatum*
9. reflexed part projecting up to 4 cm, matted-tomentose, narrowly zonate with exposed cutis, later becoming greenish from algae.....*S. subtomentosum*

## 적 요

현재까지 국내에 보고된 꽃구름버섯은 포함 5종으로서 그중 4종은 흰테꽃구름버섯(*Stereum gausapatum*), 꽃구름버섯(*S. hirsutum*), 갈색꽃구름버섯(*S. ostrea*), 및 배착꽃구름버섯(*S. ochraceo-flavum*)이며, 나머지 1종은 거북꽃구름버섯속에 속하는 너털거북꽃구름버섯(*Xylobolus spectabile*)으로서 낭상체의 형태적 특징에 의하여 거북꽃구름버섯속(*Xylobolus*)에 속하여 왔으나, Boidin과 Chamuris는 배양학적 특징에 의하여 후자를 꽃구름버섯속(*Stereum*)으로 분류하고 있다. 본 연구에서는 “너털거북꽃구름버섯”(X.

*spectabile*)을 꽃구름버섯속에 재분류하여 분류체계를 개선하고 우리말 이름을 “너털꽃구름버섯”(X. *spectabile*)으로 개칭하는 바이다. 또한 서울대학교 표본실(Seoul National University Fungal Collection, SFC)에 보관되어 있는 꽃구름버섯을 대상으로 조사한 결과 5종의 꽃구름버섯종들이 미기록종으로 동정되었으며, 이들 미기록종은 *Stereum subtomentosum*(갈색털꽃구름버섯, 신칭), *S. peculiare*(겹질꽃구름버섯, 신칭), *S. sanguinolentum*(유혈꽃구름버섯, 신칭), *S. striatum*(줄무늬꽃구름버섯, 신칭), 및 *S. complicatum*(복합꽃구름버섯, 신칭)이었다. 이로서 한국산 꽃구름버섯종들은 포함 10종에 이르며 본 연구를 통하여 국내 꽃구름버섯의 동정을 위하여 새로운 검색표를 제시하였다.

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