

A Review of Cortinarii with Boletoid Spores

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Taxa with lean, narrowly fusoid spores in the genus *Cortinarius* are reviewed and the discussion focusses on the interpretation of two names: *C. heterosporus* Bres. and *C. aureifolius* Peck. Type material and own collections have been investigated, including SEM studies and DNA sequencing. The name *C. heterosporus* is lectotypified.

Key-words: Agaricales, *Cortinarius*, *Pinus*, mycorrhiza.

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Introduction

A few species of *Cortinarius* produce remarkably long, lean, fuse-shaped ("boletoid") spores, a character known to be extremely rare in the genus. The spores look, in addition, almost smooth when examined in a light microscope. These smallish, often hygrophanous fungi in subgenera *Telamonia* and *Dermocybe* include:

- *C. heterosporus* Bres. This fungus is described as brownish with yellow gills and a white veil [Bresadola 1885]. Among J. Bresadola's material (herb. S.), there are two collections labelled *C. heterosporus* but only one of them is reasonably consistent with the protologue. An SEM examination of the latter reveals a spore surface provided with fine warts (Fig. 1). N. Arnold [1993] describes *C. heterosporus* with yellow or ochraceous gills, and with a veil that is often reddish, a coloration stated to be fugaceous. M. Moser [1997] did not see it in his own collections and suggests that red-veiled specimens should be regarded as a form or a variety.
- *C. aureifolius* Peck. This taxon is described by C.H. Peck [1885] with more vivid hues. It contains anthrachinonic pigments and apparently belongs in subg. *Dermocybe*. The stipe is yellowish with orange to orange-brown veil fibrils on the lower part. The spores are somewhat longer than in *C. heterosporus* and an SEM examination reveals that the spore surface is finely punctuate (Fig. 3a). The species is known from one locality in southern Sweden [Jacobsson 1981].

One may note that *C. aureifolius* ss. Orton [1958] (= ss. Mos. 1983), which does not possess the lean, fusoid spores of Peck's fungus, is probably a different species. It has been found by one of us [coll. KS-CO752] in Northern Sweden.

- A dermocymboid species with a golden-yellow veil and fusoid spores measuring $7.5-9.3(10) \times 3.2-4(4.5) \mu\text{m}$. Unfortunately there is only one collection of this apparently undescribed species (KS-CO86), found with *Populus tremula*. A similar taxon has been found under *Picea* in Norway with spores $7-9 \times 3.5-4.5 \mu\text{m}$ (E. Bendiksen, pers. comm.).

[Note after publication: The latter species was published in 2008 as *C. aureovelatus* Bendiks. & al. It has been collected several times later by one of the authors (KS). Like *C. heterosporus*,

C. aureifolius belongs to subg. *Telamonia* s. str., as shown by molecular markers. — Collection KS-CO752, mentioned above, has turned out to be a form of *C. bataillei* (Favre ex Mos.) Høil.]

***Cortinarius heterosporus* Bres. 1885**

Fig. 1-2, Colour Plate 1-2

1. The original material

Brief description based on Bresadola's protologue:

Cap 2–3.5 cm, rounded, later expanded, depressed or depressed-umbilicate, chestnut-brown to reddish-brown, margin with white fibrils, later lacerate-incised. *Gills* crowded, adnate, yellow-ochraceous, later spotted darker brown. *Stipe* 1.5–3 cm × 3–5 mm; almost equal, concolorous with cap, at first with white fibrils, later glabrous. *Flesh* yellow-incarnate; without special smell or taste.

Spores elongate-sinuate (like in *Boletus*), golden-yellow, almost smooth, hardly punctuate, 7–9.5 × 3 μm; *basidia* clavate 30 × 6–7 μm.

DISCUSSION

Bresadola based his description on material sent to him by J. Hennings, who collected it near Berlin. Apparently Bresadola never saw fresh material himself but nevertheless depicts the species in *Iconographia Mycologica* 1930. The general impression is a fungus with rather warm colours (cap "*castaneo vel badio-rufescens*" and gills "*ochraceo-luteis*").

Among Bresadola's original material in Stockholm there are two convolutes labelled "*Cortinarius heterosporus*", ostensibly in Bresadola's hand-writing. Only one of these, without further herbarium identification, contains material that microscopically matches the protologue. Its spores are boletoid, measuring 8–10 × 2.5–3 μm. An examination in SEM of this collection reveals a spore surface provided with fine warts (Fig. 1). The second collection possesses ellipsoid spores measuring about 9 × 5 μm; this additionally bears the mention "n. sp." as well as a herbarium number (2505) in the same hand-writing. It is evident that the latter is a different species, incompatible with the protologue, at least concerning the microscopic characters. It is impossible to know whether the macroscopic description is based on both collections or not.

According to our investigation, no type has so far been designated for Bresadola's name. We therefore designate a lectotype below, and choose the collection with the boletoid spores.

2. Later interpretations

J. Lange [1938] describes a find of *C. heterosporus* in Denmark that fits Bresadola's species rather well. M. Moser [1997] reports abundant finds of *C. heterosporus* in the United States and gives a detailed description, which includes a white to greyish veil, pale ochre to yellow-brown gills, and spores measuring 7.6–10.6 × 2.3–3.5 μm, well in agreement with our study of the type, as well as with our own finds.

However, Moser's first interpretation [1983] was based on a collection by C. Bas (*sub C. stenosporus* ined.; *pers. comm.*), a taxon with a reddish veil and spores 7.5–10.5 × 2.5–3.7 μm. Apparently the same taxon has been collected by N. Arnold [1993].

Finally, a collection, made by L. Söderberg under *Pinus* in coastal sand dunes in southernmost Sweden, 1999-10-17, seems to fit *C. heterosporus* ss Arnold. In this collection the fruit-bodies displayed a whitish cortina but a partly orange-tinted veil (Colour Plate 2).

3. Description of own finds

Cap 1-3(4) cm, rounded, later ± plane with an incurved margin. *Cutis* dry, hygrophanous, dark red-brown to umber with an almost black centre; surface matt, finely innate fibrillose to finely squamulose; margin paler greyish-brown, coarsely fibrillose but not sulcate.

Gills young grey to pale brownish-grey; distant (L=26, I=2), broad. *Cortina* not seen.

Stipe 2.5–4 cm × 2–6(8) mm; cylindrical, often with a small, rounded bulb; dirty greyish-brown, darker towards base, flushing darker grey-brown, with greyish-brown, sparse fibrils; greyish-white at apex, occasionally with a faint, blue tinge. *Veil* greyish-brown, sparse.

Flesh greyish-brown; odour and taste nil.

Reaction with NaOH blackish (trivial). *Spore print* yellowish rusty-brown.

Microscopy (in 5% NH₃) : Spores narrowly fusoid, 8.2–10.5 × 2.4–3.3 μm, weakly verrucose, practically smooth even in immersion (Fig. 2b). Basidia with 4 sterigmata, 20 × 5–6 μm. Sterile cells on gill edge numerous, hyaline, cylindrical to clavate, not differentiated, 15–25 × 4–6 μm. Epicutis of 10–15 layers of parallel hyphæ, × 6–8 μm, with a granular, brown pigment, partly encrusted. Hypoderm of cylindrical elements, evenly coloured pale brown, 25–50 × 8–15 μm (or longer), poorly differentiated from trama. Clamp connections present.

Ecology: In small groups in sandy *Pinus* forest; terrestrial; fruiting August–October; rare.

Studied collections: Bonåsheden, Mora, Dalarna, Sweden, 1999-10-03, *leg.* K. Soop KS-CO1096, herb. **S**: F13718. Same locality 1998-09-22, *leg.* K. Soop KS-CO1012. Same locality 1999-10-05, *leg.* Dan Broström DB-99-54. Tännäs, Härjedalen, Sweden, 1980-08-14, *leg.* S. Jacobsson, herb. **G**: SJ 80082.



Plate 1— *Cortinarius heterosporus*, Bonåsheden, Dalarna, Sweden, 1998-09-22 (coll. KS-CO1012), photo K. Soop.

DISCUSSION

The first impression of this small *Telamonia* is an *Inocybe* close to *I. boltonii*, a common taxon in the same sandy pine habitat. Similar remarks have been made by N. Arnold [1993]. No collection displays a veil with a reddish tint.

There are many small *Telamoniæ* with narrow spores growing in the pine heaths of the North, as well as in the corresponding biotope of sandy coastal areas. *C. semivestitus* Mos. and *C. violilamellatus* Pears. ex Orton differ by their wider spores (of the order 4–5 μm), whereas those of *C. lux-nymphæ* Melot and *C. depressus* Fr., common in the locality, are shorter (6–8 μm). *C. aureifolius* Peck differs by a yellow to orange-brown veil and even smoother spores (Fig. 3).

The only taxon known to us that might fit our fungus is *C. heterosporus*. As apparent from the above description the general coloration is in agreement with the protologue, except that the gills are said to be "*ochraceo-luteis*", and the veil is white rather than brownish (possibly the cap also exhibits a somewhat livelier hue).

DNA sequencing (see below) shows our taxon to be identical to *L. Söderberg*'s mentioned above. The latter collection exhibited the reddening veil that was found with some earlier interpretations of the name. We therefore assume that the variations in veil colour must depend on environmental factors without any taxonomic significance, and conclude that our taxon should be named *C. heterosporus*.

Similar variations in the red component of the veil colour is not unknown in *Cortinarius* subg. *Telamonia*. One example is *C. miraculosus* Melot [1979], another is *C. heterocyclus* Soop [1990], and it has also been observed with *C. præstigiosus* (Fr.) Mos. (M. Moser, *pers. comm.*).

4. Lectotypification

Collection at Herb. **S**, the convolute labelled "*Cortinarius heterosporus* Bresadola" but not "*n.sp.*" is designated as lectotype for the name *Cortinarius heterosporus*.

Cortinarius aureifolius Peck 1885

Fig. 3, Colour Plate 3

Syn: *C. ammophilus* Amm. & Smith 1969 (see also Ammirati 1988).

Brief description based on Jacobsson [1981] and later records from the same locality:

Cap 1.5–3.5 cm, flattened when mature, not umbonate, dry, floccose, warm (reddish) brown with a flush of yellow towards the margin. *Gills* fairly crowded, adnate to slightly decurrent, yellow, later brownish. *Stipe* 2–3 cm × 2–5 mm, pale yellow, in the lower part with orange to orange-brown velar fibrils.

Microscopy: spores 10–13 × 2.5–3.5 μm, oblong, lean (boletoid), smooth when seen in an ordinary microscope but finely punctuate in SEM (Fig. 3a, 3b). Cystidia absent. Clamp connections present.

Ecology: in small groups on naked sand, not far from *Pinus*.

Studied collections: USA, N.Y. State, Karner, sandy soil under pine, Oct. 1884, C.H. Peck (holotype, herb. MICH). Sweden, Småland, Slättö Sand, 1977-10-13, *leg.* S. Jacobsson, herb. **GB**: SJ 77333. Same locality 1984-10-06, *leg.* S. Jacobsson, herb. **GB**: SJ 84127.

DISCUSSION

Cortinarius aureifolius is in several respects very similar to *C. heterosporus*. It is about the same size, has a brownish cap and yellow gills, similarly shaped spores and grows in the same habitat. When it was found the first time [Jacobsson 1981], it was therefore suggested that it might be co-specific with *C. heterosporus*, although the white veil described by Bresadola and the somewhat larger spores were contradictory.

A thorough investigation reveals that there are clear differences between the two species. *C. aureifolius* is apparently a *Dermocybe*, not unlike *C. croceus*, but with a more floccose cap surface and a reddening veil. The spores are somewhat longer than those of *C. heterosporus* and their surface structure is different. In SEM (Fig. 3a) it was found that the spores of the Swedish collection were finely punctuate and not of the type found with *heterosporus*. The spores of the type possessed the same type of spore structure as the Swedish collection.

We do not know of any other certain records from Europe. There is at least one published record [Orton 1958] but the broader spores indicate that it must be another species. Possibly collections exist in other herbaria, but they have not been checked in this study.

DNA-sequencing

One collection each of *C. aureifolius* (SJ 84127), *C. heterosporus* (coll. L. Söderberg), and *C. heterosporus* (herb **S**: F13548) have been sequenced by E. Larsson, Dept. of Systematic Botany, Gothenburg University. rDNA from the regions ITS1, 5.8S and ITS2 were studied. There were considerable differences in the ITS-regions between the two species, which shows they are not closely related. On the other hand, the analysis showed no difference between the two

collections identified as *C. heterosporus*. Attempts to get sequences from the type collections of either species were unsuccessful.

The sequences have been submitted to GenBank, receiving accession numbers AF268893 (*C. aureifolius*), and AF268894 (*C. heterosporus*).

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See the article in the Journal des JEC issue for the following illustrations:

- Fig. 1 *Cortinarius heterosporus*, SEM of lectotype collection.
- Fig. 2a *Cortinarius heterosporus*, SEM of collection herb **S**: F13548.
- Fig. 2b *Cortinarius heterosporus* (coll. **S**: F13548), spores.
- Fig. 3a *Cortinarius aureifolius* SEM of coll. **GB**: SJ 84127.
- Fig. 3b *Cortinarius aureifolius* (coll. **GB**: SJ 84127), spores.
- Plate 2. *Cortinarius heterosporus*, Sweden, Skåne, 1999-10-17, herb. and photo L. Söderberg.
- Plate 3. *Cortinarius aureifolius*, Sweden, Småland, Slättö Sand, 1984-10-06, (coll. **GB**: SJ 84127), photo S. Jacobsson.