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## **NIEMELAEA, A NEW GENUS OF MERULIACEAE (BASIDIOMYCOTA)**

### **SUMMARY**

The paper deals with little-known taxa of resupinate tinder fungi which were regarded till now in artificial genus *Ceriporiopsis*. These fungi have rather uniform superficial characteristics (light-colored prostrate annual basidiomata with tubular hymenophore and wide ellipsoid basidiospores), but differ each from others by thin features of key structures and plectological organization. A total of four taxonomical entities, *Ceriporiopsis balaenae*, *C. consobrina*, *Fibuloporia cremea*, and *Porpomyces mucidus* were analyzed highlighting their spore and hyphal wall features, microchemical reactions and features of plectenchymatic organization. It is shown that *Ceriporiopsis balaenae* is a synonym of *C. consobrina*, and this entity should be placed together with *Fibuloporia cremea* in independent genus, whereas *Porpomyces mucidus* has rather isolated position. A new genus, *Niemelaea* is created for *Ceriporiopsis consobrina* and *Fibuloporia cremea*, and three new combinations, *Niemelaea consobrina*, *N. consobrina* var. *balaenae*, and *N. cremea* are proposed. The differences of new genus from the rest *Ceriporiopsis* units was presented.

**Keywords:** fungi, Meruliaceae, new genus, resupinate polypores, Polyporales

### **INTRODUCTION**

The resupinate polypore *Ceriporiopsis consobrina* (Bres.) Ryvar den was described as *Poria consobrina* Bres. from North Italy and characterized by hard ceraceous tubes with pores 0.3–1 mm in diam. and pip-shaped basidiospores 3–4 × 2.5–3 µm (Bourdot & Galzin, 1925). The generic placement of this fungus initially was based on its porioid morphotype, monomitic hyphal system without tube gelatinization and inamyloid rather wide basidiospores (Ryvar den, 1988). This fungus was recorded time to time in Southern France growing on hardwoods (Pieri, Rivoire, 1996).

According to Tura et al. (2008), this species is closely related, if not identical to *Ceriporiopsis balaenae* Niemelä, the fungus described from Canada, Quebec (Niemelä, 1985) growing on dry branch of *Salix planifolia*. During a

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time, *C. balaenae* was sporadically recorded from Central Europe (Czech Republic, Slovakia) (Vampola, Pouzar, 1996), North Europe (Sweden, Finland) (Kinnunen, Niemelä, 2005), and also from Far East (Núñez, 2001) and European Russia (Spirin, Zmitrovich, 2003; Ezhov, Zmitrovich, 2015; Khimich *et al.*, 2015).

The generic placement of the second species was associated to *Ceriporiopsis*, too, but later the affinity of *C. balaenae* to the genus *Porpomyces* which was described by Jülich for trechisporoid *Polyporus mucidus* Pers. was suspected by Spirin (2001) and a new combination *Porpomyces balaenae* (Niemelä) Spirin *et Zmitr.* was proposed (Spirin & Zmitrovich, 2003). Molecular evidence (Tomšovský *et al.*, 2010), however, has debunked such placement and keeps this species into merulioid radiation. On the other hand, the generic unit *Ceriporiopsis* in Ryvardenian sense seems to be life form rather than a natural taxon: a lot of thin features of basidiocarp organization can be obtained in precise material examination. The purpose of the present paper is generalization on morphology of *C. consobrina* and some similar taxa, which has been adapted to *Porpomyces* concept in various times and morphological testing of current generic concepts within this conglomerate.

## MATERIAL AND METHODS

The following material was examined during the presented work.

*Ceriporiopsis balaenae*. Canada. Poste-de-la-Baleine, on dry branches of *Salix planifolia*, coll. and det. T. Niemelä 12 VIII 1982 (H, holotype). Finland. Utsjoki, on dry *Salix* branch, coll. and det. H. Kotiranta 16 VIII 1987 (H, dupl. in LE). Russia. Arkhangelsk Region, Onega district, the Kiy archipelago, willow floodland, on dry branches of *Salix* sp., coll. O. N. Ezhov, A. V. Ruokolainen, 17 VII 2014 (AR 1880); Kotlas district, willow floodland, on dry branches of *Salix* sp., coll. O. N. Ezhov, 1 VIII 2014 (AR 2255). Murmansk Region, the neighborhood of the village Jäniskoski, willow thickets beside the path, on fallen log of *Salix* sp., coll. Yu. R. Khimich 17 IX 2009 (INEP 550); Pasvik reserve, birch herb-covered forest, on dry branches and fallen log of *Salix* sp., coll. Yu. R. Khimich 09 VIII 2012 (INEP 1259, INEP 1304). Leningrad Region, Lisino, on dry *Salix caprea*, coll. M. A. Bondartseva, det. W. A. Spirin and I. V. Zmitrovich 03 IX 1960 (LE 19420); Nizhne-Svirsky reserve, aspen forest of *Vaccinium myrtillus*-type, on fallen log of *Populus tremula*, coll. N. I. Kalinovskaya, A. G. Myasnikov 30 VII 2014 (LE 303705).

*Ceriporiopsis consobrina*. Israel. Massada, mixed forest with *Quercus calliprinos* and *Q. boissieri*, on deciduous wood, coll. Y. Ur (HAI 0109); Bar'am, mainly *Q. calliprinos* forest, on oak bark, 09.03.2007, leg. I.V. Zmitrovich, D. Tura and V. Malysheva (HAI 0110).

*Fibuloporia cremea*. Russia. Kamchatka Region, Klyuchi, on fallen log of *Populus suaveolens*, coll. and det. E. Parmasto 18 VIII 1960 (TAA 13599, isotype); Kozyrevsk, on fallen log of *Populus suaveolens*, coll. and det. E. Parmasto 22 IX 1960 (LE 25606).

*Porpomyces mucidus*. Russia. Leningrad Region, Vyborg district, on timber wood, coll. A. S. Bondartsev 1908 (LE 208328); Vsevolozhsk district, mixed forest, on fallen log of *Populus tremula*, coll. and det. V. M. Kotkova 5 X 2012 (LE 290641). Tver Region, Nelidovo district, herb-rich spruce forest, on fallen log of *Picea abies*, coll. and det. V. M. Kotkova (LE 290209). Nizhegorod Region, Vetluga district, fire-spruce-lime forest of *Oxalis*-type, on stump of *Picea abies*, coll. and det. W. A. Spirin 12 VIII 1999 (LE 210880).

The microscopic characters were studied in Karl Zeiss-Lab.A1 microscope (10/100 $\times$ , oil immersion). The chemical reagents used in the microscopic examination were 5% solution of potassium hydroxide (KOH), Melzer's reagent (IKI) and Cotton Blue (CB). The measurements have been made in CB; total of 30 hyphae and spores from each specimen were measured. For presenting a variation of spore size, 5% of measurements have been excluded from each end of the range, and are given in parentheses.

The record IKI- means a negative reaction of cell walls with Melzer's reagent (J2 in 5% KJ solution); the record CB- means a negative reaction with Cotton Blue reagent; the record Qm means median spore quotient ( $Q = L/W$ , where L is a spore length, W is a spore width).

## RESULTS AND DISCUSSION

The results of comparative plectological analysis are generalized in Table 1. As it seems, the *Porpomyces mucidus* characteristics are sufficiently deviated from those of *Ceriporiopsis balaenae*, *C. consobrina* and *Fibuloporia cremea*.

The hyphae in all tissues of *Porpomyces mucidus* are rather uniform. They more or less isodiametric, straight between septa, with minute clamps. The hyphal wall is a bit thickened, but lumen is sufficiently wider. The branching pattern of the hyphae is more or less dichotomous and growth is centrifugal. In plane, the hyphal masses are slightly dextrinoid in densely packed areas. In tube trama the hyphae arranged with formation of *textura intricata*, in the subiculum are loosely interwoven. The crystalline excreted material is finely granular, but large pyramidal crystals are presented in some areas. The basidiospores of *P. mucidus* (see Table 2) are also deviating due to slightly thickened and finely rough wall and non-refractive contents.

In contrast to *P. mucidus*, the hyphae in *Ceriporiopsis balaenae*, *C. consobrina*, and *Fibuloporia cremea* are differentiated into two kinds: hyaline ones, predominating in the subiculum, and bearing refractive contents ones, presented in tube trama (predominating here in *Ceriporiopsis balaenae* and *C. consobrina* and moderately presented in *Fibuloporia cremea*). The hyphal walls are a bit thickened, inamyloid (seemingly amyloid in the subiculum after heating) and indextrinoid, but in refractive hyphae the walls seen to be indistinguishable. Appearance of the hyphae in all three entities is "phanerochaetoid": they are rather wide, furnished by large eyed clamps (like those of *Phanerochaete tuberculata*), in many sites having a parallel branching pattern.

Table 1. Hyphal characteristics of some *Porpomyces*, former *Ceriporiopsis* and former *Fibuloporia* representatives

Characters	<i>Porpomyces mucidus</i>	<i>Ceriporiopsis balaenae</i>	<i>Ceriporiopsis consobrina</i>	<i>Fibuloporia cremea</i>
Diameter	2–3(4) $\mu\text{m}$	(2)2.5–5 $\mu\text{m}$	(2)2.5–4.8 $\mu\text{m}$	2.5–5 $\mu\text{m}$
Cells	isodiametric	anisodiametric	anisodiametric	anisodiametric
Walls	slightly thickened, weakly dextrinoid in tube trama	prominent, indextrinoid, inamyloid or (in the subiculum) seemingly amyloid after heating	prominent, indextrinoid, inamyloid or (in the subiculum) seemingly amyloid after heating	slightly thickened, indextrinoid, inamyloid
Contents	hyaline	hyaline in subicular hyphae, refractive (yellowish-greenish, homogeneous) in the most of tramal ones	hyaline in subicular hyphae, refractive (yellowish-greenish, homogeneous) in the most of tramal ones	hyaline in subicular hyphae, refractive (yellowish-greenish, homogeneous) in the some tramal ones
Clamps	minute, of normal appearance	swollen, eyed, pseudoclamps	swollen, eyed	swollen, eyed
Branching pattern	dichotomous	dichotomous, parallel	dichotomous, parallel	dichotomous, parallel
Growth organization	growth radial, mycelium condensation with formation of <i>textura intricata</i>	growth radial in the subiculum with diverticulate tendency in tramal areas, mycelium condensation with formation of <i>textura oblita</i>	growth radial in the subiculum with diverticulate tendency in tramal areas, mycelium condensation with formation of <i>textura oblita</i>	growth radial in the subiculum with diverticulate tendency in tramal areas, mycelium condensation with formation of <i>textura oblita</i>
Crystalline deposits	small (up to 2 $\mu\text{m}$ in longest dimension) grain-like crystals, and occasional large pyramidal crystals more or less evenly distributed over the hyphae	1) large (usually more than 2 $\mu\text{m}$ in longest dimension) plane triangle, trapezoid or pentagonal crystals; 2) small resinous-crystalline droplets in large deposits areas	1) large (usually more than 2 $\mu\text{m}$ in longest dimension) plane triangle, trapezoid or pentagonal crystals; 2) small resinous-crystalline droplets in large deposits areas	small resinous-crystalline droplets in large deposits areas

Basically, the centrifugal hyphal growth in three entities is combined with diverticulate pattern in tramal areas with formation of *textura oblita*.

Scattered along the hyphae granular crystalline matter is not characteristic for all the three entities. The crystalline deposits in *Ceriporiopsis balaenae* and *C. consobrina* of two types: 1) plane triangle, trapezoid, or pentagonal matter, 2) small resinous-crystalline deposit areas. The crystalline deposits in *Fibuloporia cremea* is presented by second type only. The basidiospores in all three entities, in contrast to those of *Porpomyces mucidus*, have the refractive contents. Their smooth walls are prominent, but not thickened. In *Fibuloporia cremea*, they are in median larger than in pair *Ceriporiopsis balaenae*–*C. consobrina*.

Table 2. Basidiospores characteristics of some *Porpomyces*, former *Ceriporiopsis* and former *Fibuloporia* representatives

Characters	<i>Porpomyces mucidus</i>	<i>Ceriporiopsis balaenae</i>	<i>Ceriporiopsis consobrina</i>	<i>Fibuloporia cremea</i>
Dimensions	(2.3)2.5–3.5(4.0) × 1.9–2.5 μm; Qm = 1.6	3.4–4.2(4.8) × 2.5–3.2(3.8) μm; Qm = 1.3	(3.4)3.5–4.9 × (1.9)2–3.5(3.6) μm; Qm = 1.5	(4.5)4.7–5.4 × 2.7–3.1 μm; Qm = 1.7
Walls	slightly thickened, basically even, a bit scrupore under immersion due to perisporium folds, inamyloid, acyanophilous	prominent, even, inamyloid, acyanophilous	prominent, even, inamyloid, acyanophilous	prominent, even, inamyloid, acyanophilous
Contents	hyaline	refractive, yellowish-greenish, subhyaline near the wall	refractive, yellowish-greenish, subhyaline near the wall	refractive, yellowish-greenish, subhyaline near the wall

As a whole, three entities – *Ceriporiopsis balaenae*, *C. consobrina* and *Fibuloporia cremea* – are uniform in basic features and sharply differ from *Porpomyces mucidus*. Furthermore, an independent status of *Ceriporiopsis balaenae* and *C. consobrina* seems to be ambiguous, whereas *Fibuloporia cremea* seems a good isolated entity. Therefore, a separate generic unit should be accommodated for these. The name *Fibuloporia* Singer is not suitable, because it is a taxonomic synonym of *Trechispora* P. Karst. The type of *Ceriporiopsis* Domański (*Poria givlescens* Bres.) represents a tubulose *Phlebia* Fr. The necessity of new name creation is obvious for this situation. Below we describe a new genus for the situation in question.

### TAXONOMICAL CONCLUSIONS

*Niemelaea* Zmitr., Ezhov et Khimich gen. nov. (MB 811684).

Basidiomes resupinate, poriid, annual, with ceraceous tubular hymenophore having rather large, thin-walled angular pores. Hyphal system monomitic. Hyphae of phanerochaetoid appearance, with large oculate clamps

and parallel branching pattern, hyaline and loosely arranged in the subiculum. In tube trama hyphae having diverticulate growth pattern and represented both hyaline and refractive elements. The hyphal walls are prominent, but not thickened, basically inamyloid (seemingly amyloid in the subiculum after heating) and acyanophilous. Cystidia none. Basidia clavate, with weakly expressed medial constriction, basically up to 20  $\mu\text{m}$ , 4-spored, with large basal clamp. Basidiospores widely ellipsoid, with homogeneous refractive contents, with prominent smooth walls (imitating slightly thick-walled), inamyloid, acyanophilous.

Table 3. The differential table for *Niemelaea* and the rest *Ceriporiopsis* derivative generic units

Generic unit	Spores	Basidia	Hyphae	Growth characters
<i>Niemelaea</i>	ellipsoid, with prominent wall and refractive contents, CB-, IKI-	basically up to 20 $\mu\text{m}$ , medial constriction not pointed	with large eyed clamps and prominent walls, indextrinoid, in the subiculum seemingly amyloid after heating	branching pattern dichotomous or parallel, growth radial in subiculum and diverticulate in tube trama
<i>Ceriporiopsis</i> Domański s. str.	subballantoid, thin-walled, hyaline, CB-, IKI-	basically up to 20 $\mu\text{m}$ , clavate with pointed medial constriction	with normal clamps, hyaline, thin-walled, CB-, IKI-	branching pattern dichotomous, in tubes gelatinizing
<i>Raduliporus</i> Spirin et Zmitr.	ellipsoid to comma-shaped, with prominent wall, hyaline, CB+, IKI-	basically over 25 $\mu\text{m}$ , clavate-pedunculate, with pointed medial constriction	with large eyed clamps and prominent walls, hyaline, CB+, IKI-	branching pattern dichotomous or parallel
<i>Pouzaroporia</i> Vampola	ellipsoid, with prominent wall, hyaline, CB-, IKI-	basically up to 20 $\mu\text{m}$ , clavate with pointed medial constriction	with large eyed clamps and prominent walls to thick-walled, hyaline, CB+, dextrinoid	branching pattern dichotomous or parallel
<i>Porpomyces</i> Jülich	broadly ellipsoid to subglobose, with slightly thickened wall, basically even, but externally a bit scrupose, hyaline, CB-, IKI-	basically up to 16 $\mu\text{m}$ , clavate without pointed medial constriction	with normal clamps, hyaline, with prominent walls, CB-, slightly dextrinoid after heating	branching pattern dichotomous

Type: *Poria consobrina* Bres., 1925.

Causes a white rot of hardwoods.

Etymology: The genus is named of honor Prof. Tuomo Niemelä – a great Finnish polyporologist, who described the *Ceriporiopsis balaenae* and find after heating a weak amyloid reaction in basal hyphae of this species.

The differences of newly described genus from former *Ceriporiopsis*-kins are summarized in Table 3.

Two species we recognize in the genus.

1. *Niemelaea consobrina* (Bres.) Zmitr., Ezhov et Khimich comb. nov. (MB 811685).

Basionym: *Poria consobrina* Bres., Bull. trimest. Soc. mycol. France 41(2): 230, 1925.

= *Ceriporiopsis consobrina* (Bres.) Ryvardeen, Mycotaxon 33: 307, 1988.



Figure 1. *Niemelaea consobrina* (LE 303705): a general view of the basidiome.

Scale bar – 5 mm.

Var. *consobrina*. Basidiomata resupinate, annual, soft when fresh, hard when dry (dry specimen), adnate. Hymenophore poroid, as a single tube layer up to 3 mm thick, pores angular, irregular, 1–2 per mm, angular, rufescent to pale ochre, with slightly dentate dissepiments. Margin narrow, mucedinous and somewhat lighter than remaining fruitbody. Context whitish and very thin (barely observable), up to 0.4 mm thick. Hyphal system monomitic. Hyphae hyaline in subicular hyphae, refractive (yellowish-greenish, homogeneous) in the most of

tramal ones, (2)2.5–4.8  $\mu\text{m}$  in diam. (wall prominent, indextrinoid, inamyloid or in the subiculum seemingly amyloid after heating), growth radial in the subiculum with diverticulate tendency in tramal areas, mycelium condensation with formation of *textura oblita*. Crystalline encrustation presented by 1) large (usually more than 2  $\mu\text{m}$  in longest dimension) plane triangle, trapezoid or pentagonal crystals; 2) small resinous-crystalline droplets in large deposits areas. Cystidia or other sterile elements lacking. Basidia clavate with a basal clamp, 7–20(25)  $\times$  4–5  $\mu\text{m}$ . Basidiospores ellipsoid to subglobose, smooth, with refractive contents and prominent walls, (3.4)3.5–4.9  $\times$  (1.9)2–3.5(3.6)  $\mu\text{m}$ ; Qm = 1.5, IKI-, CB-.

On dead wood of *Quercus boissieri*, *Q. calliprinos*, and other Mediterranean hardwoods causing white rot.

Var. *balaenae* (Niemelä) Zmitr., Ezhov et Khimich comb. nov. (MB 811686).

Basionym: *Ceriporiopsis balaenae* Niemelä, Naturaliste Can. 112(4): 449, 1985.

$\equiv$  *Porpomyces balaenae* (Niemelä) Spirin et Zmitr., Karstenia 43(2): 80, 2003.

The boreal ecotype differs from type variety by paler coloration of the hymenophore (cream to straw-colored), slightly smaller pores (2–4 per mm) and spores 3.4–4.2(4.8)  $\times$  2.5–3.2(3.8)  $\mu\text{m}$ ; Qm = 1.3.

On dry branches and fallen logs of *Salix* spp. and *Populus tremula* causing white rot.

General distribution: North America (Canada, Puerto Rico), Europe (Czech Republic, Finland, France, Russia, Sweden, Slovakia), Asia (Israel, Russia).

2. *Niemelaea cremea* (Parmasto) Zmitr., Ezhov et Khimich comb. nov. (MB 811687).

Basionym: *Fibuloporia cremea* Parmasto, Issledovanie prirody Dalnego Vostoka: 255: 1963.

$\equiv$  *Porpomyces cremeus* (Parmasto) Spirin, Mycena 1: 69, 2001.

Basidiomata resupinate, annual, soft when fresh, ceraceous when dry, adnate. Hymenophore poroid, as a single tube layer up to 3(5) mm thick, pores angular, irregular, 1–2 per mm, angular, cream to yellowish, with dentate dissepiments. Margin rather wide, cordonic, radiate-fibrillose. Context whitish and very thin (barely observable), up to 0.2 mm thick. Hyphal system monomitic. Hyphae hyaline in subicular hyphae, refractive (yellowish-greenish, homogeneous) in the some tramal ones, 2.5–5  $\mu\text{m}$  in diam. (wall slightly thickened, indextrinoid, inamyloid), growth radial in the subiculum with diverticulate tendency in tramal areas, mycelium condensation with formation of *textura oblita*. Crystalline encrustation presented by small resinous-crystalline droplets in large deposits areas. Cystidia or other sterile elements lacking. Basidia clavate with a basal clamp, 12–17  $\times$  5–6  $\mu\text{m}$ . Basidiospores ellipsoid,



smooth, with refractive contents and prominent walls, (4.5)4.7–5.4 × 2.7–3.1 μm; Qm = 1.7, IKI-, CB-.

On dead wood of *Populus suaveolens* and other *Salicaceae* causing white rot.

General distribution: Far East Russia, temperate China.

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