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Two collections of albinotic forms of *Tubaria* (Basidiomycota, *Agaricales*, *Inocybaceae*)

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The record of an albinotic *Tubaria* from the Czech Republic was studied and compared with a macroscopically similar collection from Norway. However, the two specimens represent different taxa due to both morphological characters and DNA sequences. The main microscopic characters usually used for species identification of the *Tubaria furfuracea* complex (including *T. furfuracea*, *T. hiemalis*, and *T. romagnesiana*) are discussed on the base of studied collections from the BRNM herbarium. According to our studies, the main characters (size of basidiospores, shape and size of cheilocystidia, width of the hymenophoral trama hyphae) usually used for identification of these three species are not generally applicable. Further detailed anatomic-morphological and molecular studies are desirable to solve the problem of species limits in the *Tubaria furfuracea* complex.

Key words: *Tubaria hiemalis*, *Tubaria romagnesiana*, *Tubaria furfuracea*, albinotic forms, taxonomy, ITS.

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V článku je studován sběr albinotické kržatky z rodu *Tubaria* z České republiky, který je srovnán se sběrem makroskopicky podobného albína z Norska. Podle morfologických znaků a sekvencí DNA oba sběry představují různé taxony. Tímto bylo prokázáno, že přítomnost albinotických forem není v rodu *Tubaria* omezena pouze na jediný taxon. Rovněž zde diskutujeme základní znaky používané pro určování druhů z okruhu *Tubaria furfuracea* (*T. furfuracea*, *T. hiemalis* a *T. romagnesiana*) na příkladu herbářových položek z herbáře BRNM. Podle nich nejsou tyto znaky (velikost výtrusů, tvar a velikost cheilocystid a šířka hyf tramy lupenů) použitelné zcela jednoznačně. Pouze další detailní anatomicko-morfologické studie, podpořené studiem DNA sekvencí, mohou problém identity těchto tří taxonů vyřešit.

INTRODUCTION

During his field research in late autumn 2009, the second author found an interesting entirely white coloured fungus growing on decayed wood of *Tilia*. Its microscopic characters agreed with those of *Tubaria* species; this was verified using molecular studies.

Albinotic forms occur widely within the Dikarya. These forms are occasionally described as new taxa – e.g. *Amanita phalloides* var. *alba* (Costantin & Dufour 1895), *Paxillus involutus* f. *eburneus* (Gelardi et al. 2011) or *Gyromitra esculenta* var. *alba* (Pilát 1954) – or are widely recognized without a formal description, e.g. an albinotic form of *Russula amoenolens* (Romagnesi 1967). Maas Geesteranus (1991) mentioned the presence of a white form of *Mycena speirea*, which was later (Robich 2003) described as *Mycena speirea* f. *candida* Robich. Some albinotic taxa were even described in a different genus, e.g. *Hebelomina neerlandica* Huijsman was transferred to the genus *Gymnopilus* as *G. neerlandicus* (Huijsman) Contu (Cittadini et al. 2008).

According to its macro- and microscopic characters, the Czech albinotic fungus seems to belong to the *Tubaria furfuracea* group (including *Tubaria furfuracea*, *T. hiemalis*, and *T. romagnesiana*). The taxonomy of the *Tubaria furfuracea* complex is very difficult. Because of the lack of detailed molecular studies, almost all recent publications are based on anatomic-morphological studies by Arnolds (1982) and Bon (1992). Recently, species of this complex were studied by Volders (2002). *Tubaria hololeuca* Kühner ex E. Horak & P.-A. Moreau is an only white coloured *Tubaria* species described from Europe (Bon 1992, Horak & Moreau 2004).

Arnolds (1982) distinguished three species: *Tubaria furfuracea* (Pers.: Fr.) Gillet s.str. with velar remnants present at the pileus margin, basidiospores (6.0)6.5–9.0(11) × (4.0)4.5–5.5(6.5) µm, ellipsoid or ellipsoid-oblong, sometimes slightly constricted, cheilocystidia (30)34.5–53 × 4.5–7.5(9.5) µm, subcylindrical or slightly ventricose, at apex not to rather swollen, and (6.0)8.5–20(26) µm wide hymenophoral trama hyphae; *T. hiemalis* Romagn. ex Bon with a less developed velum, slightly larger basidiospores ((6.7)7.0–9.5(10.5) × 4.5–5.5(6.0) µm), mostly distinctly apically swollen cheilocystidia, only (5)8.0–18(20) µm wide hymenophoral trama hyphae, and a later fructification; and *T. romagnesiana* Arnolds with distinct velar remnants on the pileus margin, shorter basidiospores ((5.8)6.0–8.2(8.5) × 4.0–5.2(5.5) µm), cylindrical or slightly ventricose cheilocystidia without a swollen to subcapitate apex, and only ± 4.0–10(14.5) µm wide hymenophoral trama hyphae. The same species concept was accepted by Bon (1992) and Horak (2005). Moser (1983) included two species in his key, *T. furfuracea* with a well-developed velum on the pileus margin, ellipsoid basidiospores 6–8.5 × 4–6 µm in size, and clavate (not capitate) cheilocystidia, and *T. hiemalis* with an indistinct pileus velum, 8–10 × 4–5 µm large basidiospores, and mostly dis-

tinctly capitate cheilocystidia. On the other hand, Vesterholt (2008) considered all three species conspecific as *T. furfuracea* s.l. Volders (2002) made similar anatomic-morphological studies of this complex as published here, and also he considers all three taxa conspecific. However, he distinguished *T. furfuracea* var. *furfuracea* with (8)10–20(30) µm wide trama hyphae and 6.5–9(11) × 4.5–5.5(6.5) µm large basidiospores, var. *furfuracea* f. *romagnesiana* (Arnolds) Volders with 4–10(15) µm wide trama hyphae and rather thick-walled, 6–8 × 4–5 µm large basidiospores, both without distinctly capitate cheilocystidia, and var. *hiemalis* (Romagn. ex Bon) Volders with 10–20(30) µm wide trama hyphae, 7–10(11) × 4.5–5 µm large basidiospores and capitate cheilocystidia. According to LSU sequences of nuclear ribosomal RNA genes studied by Aime et al. (2009), *T. furfuracea* and *T. hiemalis* are conspecific. Nevertheless, the LSU sequences are not divergent enough to reveal differences between closely related species.

MATERIALS AND METHODS

The macroscopic description based on fresh basidiocarps was compiled by the second author, microscopic features were studied under an Olympus BX 50 light microscope from dried material mounted in H_2O, 5 % KOH solution, Melzer's reagent and Congo Red. For basidiospores, the factors E (quotient of length and width in any one spore) and Q (mean of E-values) are used. In all collections, 20 basidiospores were measured. Authors of fungal names are cited according to the International Plant Names Index Authors website (http://www.ipni.org/ipni/authorsearchpage.do). For herbarium acronyms, see Thiers (2012).

A set of specimens labelled as *Tubaria furfuracea*, *T. hiemalis*, and *T. romagnesiana* from the BRNM herbarium (Tab. 1) was studied for a discussion about the main microscopic characters used in this group for species delimitation.

Both albinotic *Tubaria* specimens from the Czech Republic and Norway were subjected to DNA analysis. DNA was isolated from dried fungal material using the PowerSoil DNA Isolation kit (MoBio, USA). DNA fragments encompassing the ITS region of rRNA genes were amplified using the following primer combinations: ITS1/ITS4 or ITS5/ITS4-Basidio (Nikolcheva & Bärlocher 2004, White et al. 1990).

The DNA was amplified with PCR as in an earlier study (Tomšovský 2012), using the Mastercycler_ep thermocycler (Eppendorf, Germany). Amplicons were custom-purified and sequenced at Macrogen (Seoul, Korea). The sequences were deposited in the NCBI Nucleotide Sequence Database.

The ITS dataset was enriched with sequences published by Matheny et al. (2007) as representatives of the *Tubaria furfuracea* complex showing high similarity to our newly obtained sequences (≥97 %) when searched by BLAST. The

Tab. 1. Revised specimens from the BRNM* herbarium. The last two lines represent albinotic forms. Abbreviations: **CZ** = Czech Republic, **I** = Italy, **N** = Norway, **NM** = National Monument, **NNM** = National Nature Monument, **NNR** = National Nature Reserve, **NR** = Nature Reserve, **PLA** = Protected Landscape Area.

BRNM number*	Locality	Ecology	Collection date	Leg.
568774	CZ, Brno-Lesná, Suchá hora hill	decaying twigs of *Quercus* or *Robinia pseudacacia*	14 March 1990	A. Vágner
576607	CZ, Podyjí PLA, Vranov nad Dyjí, Braitava NNR	leaves and cupulae of *Fagus sylvatica*	10 Sept. 1993	V. Antonín 93.170
576616	CZ, Podyjí PLA, Vranov nad Dyjí, Braitava NNR	fallen twig of *Fagus sylvatica*	10 Sept. 1993	V. Antonín 93.180
590368	CZ, Pouzdřany, Pouzdřanská step NNR	on soil in former field	10 March 1994	Z. Bieberová
590391	CZ, Mohelno, Mohelenská hadcová step NNR	twig of broadleaved tree	27 Apr. 1994	V. Antonín 94.13
599286	I, Tuscany, Capalbio, Lago di Burano	detritus of *Quercus ilex* and *Q. suber*	4 Dec. 1994	V. Antonín 94.322
603741	CZ, Mohelno, a village vicinity	fallen twigs of broadleaved tree	4 Oct. 1995	V. Antonín 95.316
612099	CZ, Lanžhot, Sekulská Morava NNR	wood of broadleaved tree	14 Aug. 1996	V. Antonín 96.79
612721	CZ, Lanžhot, Ranšpurk NNR	on soil under *Carpinus betulus*	15 Oct. 1997	V. Antonín 97.215
642328	CZ, Kokořínsko PLA, Vidim, Střezivojický důl valley	on soil under *Fagus sylvatica* and *Robinia pseudacacia*	15 July 1998	V. Antonín 98.17
648736	CZ, Vranovice, Plačkův les NM	decaying twigs and leaves of *Populus nigra*	18 March 1999	A. Vágner
666466	CZ, Brno-Slatina, Stránská skála NNM	on soil along path	15 Aug. 2001	V. Antonín 01.198 and Z. Bieberová
667884	CZ, Soběšice, Melatín stream valley	on soil and decaying twigs of broadleaved trees	9 March 2002	V. Antonín 01.03
691232	CZ, Moravský kras PLA, Vilémovice, Výměry Punkvy NNR, Suchý žleb gorge	detritus and twigs of *Picea abies*	14 May 2004	V. Antonín 04.10
693604	CZ, Bílé Karpaty PLA, Suchov, Porážky NNR	decaying twigs of *Quercus robur*	4 Nov. 2004	V. Antonín 04.295
695418	CZ, Soběšice, U jezírka	near path in mixed stand	17 Apr. 2005	A. Vágner and M. Janoušková
695454	CZ, Moravský kras PLA, Vilémovice, Výměry Punkvy NNR, Pustý žleb gorge	detritus of *Fagus sylvatica* and *Picea abies*	11 May 2005	V. Antonín 05.04
733295	CZ, Přerov, Malá laguna NR	decaying wood of broadleaved tree	11 Sept. 2010	V. Antonín 10.319 and S. Komínková
O 370700	N, Oslo, Grorud, Groruddammen	on soil	18 Aug. 1979	E. Bendiksen
737651	Pardubice, Pohránovský rybník pond	decayed branch of *Tilia*	16 Nov. 2009	J. Kramoliš

* in one case, collection from O herbarium (Botanical Museum, Oslo, Norway) is cited

sequence of *Tubaria serrulata* (Cleland) Bougher & Matheny (DQ989330) was selected as outgroup.

Sequences were aligned using a ClustalW algorithm in BioEdit v. 7.1.3 (Hall 2011) and adjusted manually. Phylogenetic analyses were carried out in PHYML estimating maximum likelihood phylogenies and run at the server Phylogeny.fr (Dereeper et al. 2008) using the "A la Carte" mode. The alignment was treated with Gblock, eliminating poorly aligned positions and ambiguous regions, and the GTR substitution model was selected for the ITS dataset. Bootstrap branch support values (BP) were estimated in PHYML under the maximum likelihood criterion using 100 replicates (default).

RESULTS

Tubaria sp., albinotic collection from the Czech Republic

Figs. 1, 2

Pileus up to 30 mm broad, globose and closed at first, then broadening up to become applanate to funnel-shaped, with straight, undulate margin, sticky to subviscid when moist, striate-sulcate up to 1/4 of diam. when old, hygrophanous, chalk-white at centre, wax-white towards margin. Lamellae emarginate and attached with tooth or shortly decurrent, thin, ventricose, with lamellulae, covered with a fibrillose velum when very young, white, with entire concolorous edge. Stipe cylindrical with slightly broadened base, curved, slightly striate above (up to c. 1/5), finely pubescent, entirely white; basal mycelium distinct, white. Context white, thin-fleshed in pileus, solid, then slightly woolly in stipe, with indistinct, slightly earthy smell and mild fungoid taste.

Basidiospores 7.0–9.0 × 4.5–6.0 µm, average 8.1 × 5.4 µm, E = 1.33–1.89, Q = 1.50, ellipsoid, subovoid, sometimes ventrically applanate or slightly depressed. Basidia 22–30 × 7.5–12 µm, tetrasporic, clavate. Basidioles 11–27 × 4.5–11 µm, clavate or cylindrical. Cheilocystidia 32–50 × 6.0–9.0 (base) × 4.5–10 (apex) µm, fusoid, (sub)lageniform, subcylindrical, thin-walled, with cylindrical, clavate, sometimes subcapitate apex. Trama hyphae composed of cylindrical to fusoid cells, thin-walled, 2.0–15 µm wide. Pileipellis a cutis composed of cylindrical, fusoid, ± thin- to slightly thick-walled, smooth or minutely incrusted hyphae of up to c. 70 µm long and up to 12 µm wide cells; terminal cells ± appressed, 23–65 × 5.0–12 µm, clavate, fusoid, (sub)cylindrical, mostly slightly thick-walled. Stipitipellis a cutis of cylindrical, parallel, slightly thick-walled, smooth or minutely incrusted, up to 5.0 µm wide hyphae. Caulocystidia not frequent, 17–38 × 4.0–8.0 µm, cylindrical, clavate, subfusoid, thin- to slightly thick-walled. Clamp connections present in all tissues. Neither basidiospores nor hyphae amyloid or dextrinoid.

Ecology. On rather strongly decayed branch of *Tilia* sp. in a stand of secondary *Quercus rubra* and *Tilia* sp.

Collection studied. Czech Republic, Pardubice, bank of Pohránovský rybník pond, alt. 220 m, coord. 50° 04' 22.03" N, 15° 44' 49.03" E, 16 November 2009 leg. J. Kramoliš (BRNM 737651 and herb. J. Kramoliš JK773).

Phylogenetic analysis

The aligned dataset of ITS sequences was composed of 610 positions. The dataset cured with Gblock contained 571 positions (93 % of original dataset) composed of 44 variable and 22 singleton sites. Maximum likelihood analyses yielded trees with the following likelihood values and model parameters: ln= –1107.25968, invar: 0.852; f(A): 0.23683; f(C): 0.21988; f(G): 0.22100; f(T): 0.32230. The phylogeny confirmed remarkable morphological differences between the two albinotic specimens of *Tubaria* (Fig. 3). While the Norwegian one (GenBank accession number JX126809) is closely related to *T. hiemalis* and *T. praestans*, the Czech specimen (GenBank accession number JX126808) is proximal to the sequence of *T. segestria*. Nevertheless, the ITS sequences of *T. furfuracea* and *T. romagnesiana* were unavailable from the NCBI Nucleotide Sequence Database during preparation of this manuscript (June 2012).

DISCUSSION

Czech albinotic collection

According to Arnold's concept (Arnolds 1982), the Czech albinotic collection agrees well with *T. hiemalis* in the pileus having scattered velar remnants, the width of basidiospores, and the width of the hymenophoral trama hyphae, and with *T. romagnesiana* in basidiospore length, shape of cheilocystidia, and width of the hymenophoral trama hyphae (Figs. 4 and 5). The results of the DNA sequence study (Fig. 3) did not confirm its identity with *T. hiemalis*. *Tubaria hololeuca* Kühner ex E. Horak & P.-A. Moreau differs by having small, 5.5–6.5 × 4.5–5 µm (up to 7.0(7.8) × 5.5 µm in bisporic basidia), ovoid-ellipsoid basidiospores, and cylindrical to ± lageniform cheilocystidia (Horak & Moreau 2004). Therefore, the basic characters of the Czech collection do not fully agree with any taxon of the *T. furfuracea*-complex, and may also represent a different well-separated taxon.

The ITS sequence of our albinotic *Tubaria* is proximal to that of *T. segestria* (Fr.: Fr.) Boud. However, the sequence used in our study represents *T. segestria* s. Romagnesi 1962 (Matheny et al. 2007). Problems with the interpretation of this taxon were already discussed by Kühner & Romagnesi (1953). In recent literature,

Fig. 1. Albinotic *Tubaria*, Czech Republic (Pardubice, bank of Pohránovský rybník pond, BRNM 737651 and herb. J. Kramoliš JK773). Photo J. Kramoliš.

Fig. 2. Albinotic *Tubaria*, Czech Republic (Pardubice, bank of Pohránovský rybník pond, BRNM 737651 and herb. J. Kramoliš JK773). Photo J. Kramoliš.

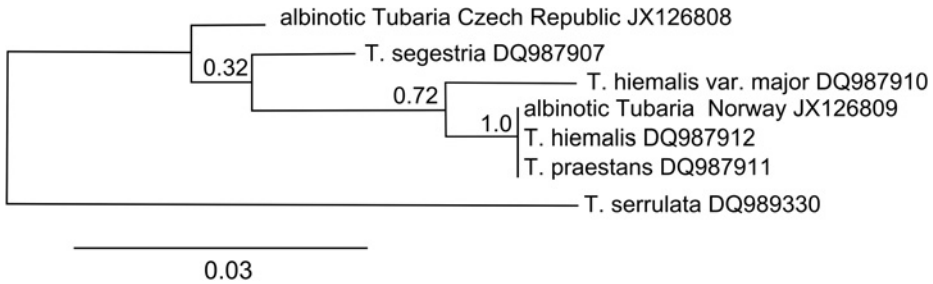
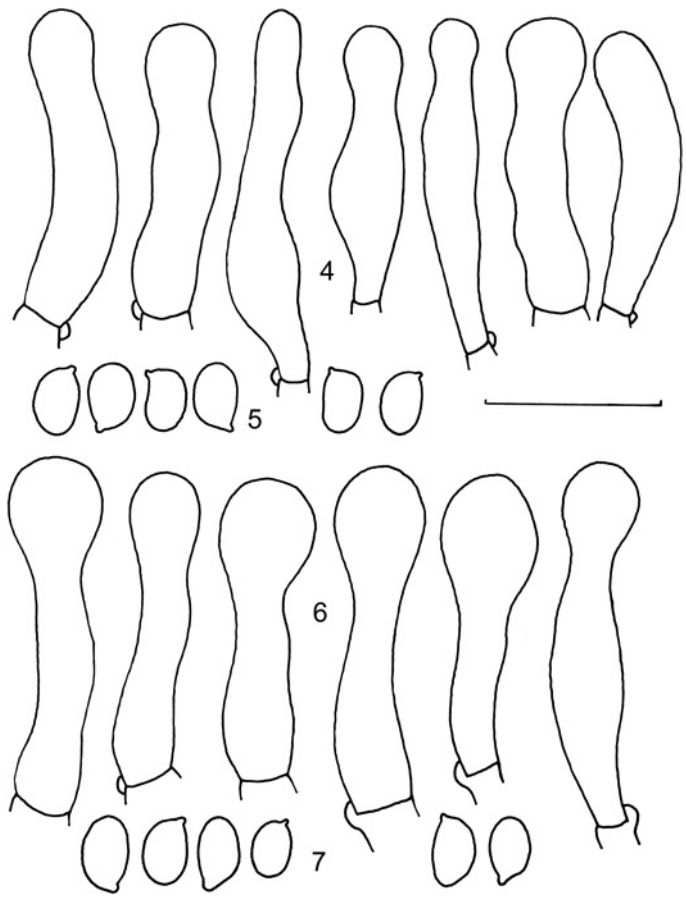


Fig. 3. Phylogram inferred from the Maximum Likelihood analysis of ITS sequences of the *Tubaria furfuracea* complex. Numbers at branches indicate bootstrap values. The bar indicates the number of expected substitutions per position.



Figs. 4.–7. Albinotic *Tubaria* collections. **4–5.** Czech Republic (BRNM 737651 and herb. J. Kramoliš JK773): **4**. cheilocystidia, **5**. basidiospores. **6–7.** Norway (O 370700): **6**. cheilocystidia, **7**. basidiospores. Scale bar = 20 µm.

Horak (2005) considers *T. segestria* s. auct. identical with *T. furfuracea*, whereas Arnolds (1982) treated *T. segestria* s. Boud. identical with *T. hiemalis*, and *T. segestria* s. Kühner et Romagn. with *T. furfuracea*. Bon (1992) distinguished two species: *T. segestria* (s. Romagn.) with basidiospores 6–7(8) × 4–5 µm and 8–12 µm wide trama hyphae, and *T. furfuracea* with basidiospores (6)7–9(11) × (3)4.5–5.5(6) µm and 10–18(25) µm wide trama hyphae.

Norwegian albinotic collection

For a comparison with our find, a herbarium specimen of another albinotic *Tubaria* collection from Norway (Oslo, Grorud, Groruddammen SE, boreonemoral zone, deciduous forest copse with *Betula*, *Salix caprea*, *Corylus*, *Acer platanoides*, *Populus tremula*, etc., earlier pastured, alt. 170 m, 18 Aug. 1979 leg. et det. Egil Bendiksen, O 370700, as *T. furfuracea*) was revised. Its velum is described as "dense, white fibres extending from the cap surface over the inrolled margin to the top of the stem, when young membranaceous, persistent for quite a long time, but never as a ring on the stipe, at least forming hanging squamules along the cap margin" (Bendiksen 1980). Our microscopic revision showed basidiospores of 7.0–8.5(9.0) × 5.0–6.0 µm in size (average 7.7 × 5.4 µm, E = 1.25–1.55, Q = 1.43), ellipsoid to subovoid, cheilocystidia 27–45 × (5.0)7.0–10 (base) × (7.0)9.0–13 µm (apex) large, mostly distinctly capitate, and up to 25(35) µm wide hymenophoral trama hyphae (Figs. 6 and 7). Except for the developed velum on the pileus margin when young, it agrees rather well with *T. hiemalis* sensu Arnolds (1982).

The ITS sequence of Norwegian albinotic *Tubaria* matched well to that of *T. hiemalis* and *T. praestans*. The proximity of the sequence to *T. hiemalis* is in accordance to its morphological characters. *Tubaria praestans* (Romagn.) M.M. Moser is a robust fungus with up to 50(70) mm broad pileus, a 40–70 × 3–5 mm large stipe, rather small basidiospores (7–7.5 × 5–6 µm), and obtuse, lageniform or clavate to sphaeropedunculate cheilocystidia (Bon 1992, Horak 2005, Moser 1983). Bon (1992) compared it with *T. hiemalis* var. *major* Bon et Trimbach, which differs by having an even more robust stipe (40–70 × 3–9 mm) and longer basidiospores (7–10(11) × 4.5–5 µm). The ITS sequences published by Matheny et al. (2007) and applied in our molecular study (Fig. 3) indicate a close relation between *T. hiemalis* var. *major* and *T. praestans*. However, *T. hiemalis* var. *major* is separated from the nominate variety of *T. hiemalis* (Matheny et al. 2007).

Characters of *Tubaria furfuracea* complex

For a discussion on the main microscopic features used for identification, we studied herbarium specimens of the *Tubaria furfuracea* complex from the BRNM herbarium (Tabs. 1 and 2). In Tab. 2, the label names of each herbarium specimen and the identifications using the main diagnostic characters (Arnolds 1982, Bon

Tab. 2. Basic microscopic characters of studied *Tubaria* collections from the BRNM* herbarium. **f** = *T. furfuracea*, **h** = *T. hiemalis*, **r** = *T. romagnesiana*.

BRNM number*	label name	Identification (main characters)	basidiospores size (µm)	basidiospores average (µm)	Q	cheilocystidia apex		trama hyphae	
						min.	max.	min.	max.
568774	f	r	7.0–8.5 × 4.5–5.5	7.6 × 4.8	1.59	7.0	9.0	6.0	35
576616	f	r	6.5–8.0 × 4.25–5.25	7.3 × 4.8	1.53	7.0	9.0	5.0	12
695454	f	r/f	7.0–8.0(9.0) × 4.5–5.25	7.9 × 4.8	1.65	5.0	9.0	5.0	25
642328	h	f/h	7.5–8.0(8.5) × 4.5–5.5	8.0 × 5.0	1.61	6.0	14	5.0	15
648736	h	h/f	7.5–8.5 × 4.5–5.25	7.9 × 4.9	1.63	5.0	7.0	5.0	20
667884	h	f/h	7.0–9.0(9.5) × 4.5–5.5(6.0)	8.0 × 5.2	1.53	7.0	10	4.0	22
693604	h	h/r	7.0–8.0 × 4.5–5.25	7.4 × 4.8	1.53	7.0	9.0	4.0	15
576607	r	r	6.75–8.0(8.5) × 4.5–5.2	7.4 × 4.7	1.56	6.0	10	6.0	24
590368	r	f/r	7.0–8.5 × 4.5–5.25	7.8 × 4.8	1.61	4.0	7.0	4.0	16
590391	r	h/f	(6.5)7.0–8.0(8.5) × (4.0)4.5–5.0	7.4 × 4.6	1.61	6.0	9.0	4.0	12
599286	r	r	7.5–9.5 × 4.5–5.5(6.0)	8.1 × 5.0	1.62	6.5	10	4.0	12
603741	r	r	7.0–8.5 × 4.5–5.5(6.0)	7.8 × 5.2	1.50	4.0	10(12)	3.0	11
612099	r	r	7.25–8.0 × 4.5–5.5	7.5 × 5.1	1.48	5.0	8.0	3.0	13
612721	r	r/h	7.5–8.5 × 4.5–5.5	7.9 × 4.9	1.61	4.0	7.5	4.0	30
666466	r	± h	7.0–8.5 × 4.0–5.25	7.8 × 4.6	1.68	10	13	5.0	25
691232	r	f/h	7.0–9.0(9.5) × 4.5–5.5(6.0)	8.0 × 4.8	1.66	6.0	8.5	4.0	22
695418	r	r/f	7.0–8.5(9.0) × 4.25–5.0	7.7 × 4.5	1.67	7.0	10	3.0	21
733295	r	r	6.0–8.0 × 4.25–5.5	6.8 × 4.8	1.42	6.0	10	4.0	14
O 370700	f	h/r?	7.0–8.5(9.0) × 5.0–6.0	7.7 × 5.4	1.43	(7.0)9.0	13	5.0	25
737651	0	r?	7.0–9.0(9.5) × 4.5–6.5	8.2 × 5.4	1.53	5.0	9.0	3.0	15

* in one case, collection from O herbarium (Botanical Museum, Oslo, Norway) is cited

1992) are summarized. Our results show that transient forms exist between these characters, and several collections are not exactly identifiable. Our results, therefore, agree with the species concept by Vesterholt (2008). Detailed studies supported by molecular data are thus necessary to solve this taxonomic problem.

CONCLUSIONS

Our studies confirmed the presence of albinotic forms in more than one *Tubaria* species. From the results and discussion it is clear that the Czech albinotic collection is very interesting and difficult to identify with the formerly described *Tubaria* species. It may even represent an independent taxon placed outside the *T. furfuracea* complex but belonging to the normally brown coloured taxa. On the other hand, we can not consider all albinotic Tubarias good species because the Norwegian collection certainly belongs to the *Tubaria furfuracea* complex.

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