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SOME NOMENCLATORIAL AND TAXONOMIC CONSIDERATIONS ON
AGARICUS SUBTESTACEUS BATSCH 1789 AND *A. TESTACEUS* FR. 1838**Abstract**

The possibility that *Agaricus subtestaceus* Batsch and *A. testaceus* Fr. may predate any modern species of the genus *Hebeloma* was explored through a careful study of the protologues and the range of their possible interpretations, of the historically relevant interpretations offered over the years, together with an evaluation of the nomenclatorial status of the names. After designating a lectotype for the two taxa, it is concluded that, since the protologues are open to conflicting interpretations, and the lack of original material (specimens) of both taxa makes it impossible to resolve satisfactorily the interpretative conflicts, it is advisable to avoid adopting such names.

Riassunto

La possibilità che *Agaricus subtestaceus* Batsch ed *A. testaceus* Fr. possano antedatate specie moderne del genere *Hebeloma* è stata presa in seria considerazione per mezzo di un attento studio dei protologhi e delle loro possibili interpretazioni, delle interpretazioni storicamente rilevanti apparse nel corso degli anni e di una valutazione dello status nomenclatoriale dei due nomi. Dopo la designazione di un lectotipus per i due taxa, si conclude che, dato che entrambi i protologhi sono suscettibili di interpretazioni confliggenti e dato che l'assenza di materiale originale (campioni d'erbario) di entrambi non rende possibile una soddisfacente risoluzione dei conflitti interpretativi, è consigliabile evitare di utilizzare tali nomi.

Key words: *A. subtestaceus*, *A. testaceus*, typification, nomenclature, taxonomy

Introduction

Batsch described and illustrated (plate XXXV, figs. 198a, b and c) *Agaricus subtestaceus* in *Elench. Fung.*, cont. sec. (Halle): 39. 1789; then FRIES (1838) described *A. testaceus* citing the fig. 198 of *A. subtestaceus*, so establishing an obvious relationship between the two names. Such a relationship became even more explicit when QUÉLET (1872) published "*Hebeloma testaceus* Batsch", in which Fries' specific epithet was followed by the name of the author of *A. subtestaceus*. Both species have traditionally been regarded as members of the genus *Hebeloma* in the current sense and our study provided no evidence against this view. Unfortunately, as is always the case with ancient names for which no microanatomical data is available, the circumscriptions of the species to which these names refer are prone to conflicting interpretations. With yet stronger reason in a genus like *Hebeloma* in which, with the exception of very few species unmistakably characterized by their gross morphology, the recourse to microanatomy is crucial.

***Agaricus subtestaceus* Batsch**

Based on all the information provided in the protologue: original description and illustrations (see fig. 198 of plate XXXV in fig. 1), the species can be basically characterized as follows:

Pileus cucullate to convex, viscid ("totus in superficie viscoso-roridus"), almost unicolorous, ochraceous-flesh-coloured ("ochraceo-carneus"), paler over the margin ("in margine albentior"). Lamellae pale fulvous to ochraceous-brown. Stipe clavate to moderately bulbous ("plus vel minus bulbosus"), dry, entirely floccose, flocci more dense and white on upper stipe ("toto floccoso-hirto", "floccis distantioribus vel confertis, revolutis, superne densioribus, et ibidem sub pileo cum stipite albis"); fistulose with apical medullary shred. Context firm, whitish. Odour and taste not recorded. Habitat in montane pinewoods, in autumn.

Agaricus testaceus Fr.

FRIES (1838) described *A. testaceus* (citing the figure 198 of *A. subtestaceus* Batsch) as a cortinate species (“*Cortina fugax*”) and a member of the “tribe” *Indusiati*:

Pileo carnosio, campan.-convexo, obtuso laevi subviscido, stipite cavo subbulboso flocculoso-fibrilloso pallido apice farinaceo, lamellis attenuato-subliberis, lanceolatis, confertis e pallido ferrugineis adscendentibus. Batsch fig. 198. A. fastibilis var. P. et vulgo. - Secr. n. 563. In silvis raro. Stipes subclavatus, basi solidus demum obscurior. Cortina fugax. Pil. 2-3 unc. testaceo-pallens subopacus. Odor raphani.

In comparison with *A. subtestaceus*, some differences must be emphasized, in particular the stipe is described as cortinate and with a flocculose-fibrillose ornamentation and the odour is said to be raphanoid.

Differences which are present also in *Hebeloma testaceum* Quélet. (QUÉLET, 1872): “*stipe [...] pâle avec des fibrilles rousses et terminé par un renflement oblongue. Cortine blanche et fugace [...] odeur faible de radis*».

Since Fries cited the figure of Batsch’s *A. subtestaceus* in the protologue of *A. testaceus*, one might think that the epithet *testaceum* is a typographical error. Nevertheless, the fact that Fries used consistently this epithet in all his later works (FRIES, 1849; 1857; 1874) as well as in the plate, here published for the first time (see below), provides compelling evidence that it cannot be considered a typographical error.

The unpublished plate (STRID, 1994; J. KLACKENBERG, pers. comm.) of “*A. (Hebeloma) testaceus* Batsch” (S 0527), conserved in the Swedish Museum of Natural History was based on a collection from Ostrogöthia, Reymyra (Östergötland, Skedevis, Rejmyre) dated “5/9 1860” and was approved by Fries. The plate (see fig. 2), which includes references to “*Epicr.* p. 178” and “*S. Veg. Sc.* p. 290, N° 547”, cannot be considered original material because it is much later; in addition, it also poses some problems of interpretation. The specimens depicted (three entire and one in section) show no evidence of a cortina, which is in conflict with the protologue, have pileus colours ranging from reddish-brown to a purplish-brown, a whitish, subcylindrical stipe, pruinose at the apex, fistulose and with a distinct apical medullary shred.

Interpretations of *A. subtestaceus* Batsch

The stipe ornamentation described by Batsch, in particular the fact that it covers the entire stipe surface (see also the fig. 198b of the original plate), and that there is no mention of a cortina, can be interpreted as evidence of a floccose to floccose-squamulose stipe (generally the macroscopic correlate of isolate or tufted caulocystidia), namely the one typical of members of *H. sect. Denudata* (Fr.) Sacc. and above all *H. sect. Velutipes* Vesterh. Even if the species of *H. sect. Denudata* may be excluded mainly on account of habitat preferences, there remains a puzzling choice among the members of the latter: first and foremost *H. leucosarx* P.D. Orton, secondarily *H. velutipes* Bruchet, and *H. celatum* (GRILLI & AL., in prep.). Also *H. quercetorum* Quadr. and *H. erebium* (GRILLI & AL., in prep.) would macroscopically match, but they can be excluded on biogeographical grounds: the first has a more southern distribution and on habitat preferences for the second. Considering the whole range of their phenetic variability, the three above-mentioned species, may, in fact, exhibit macroscopic characters congruent with those of *A. subtestaceus*. The above interpretation is not obviously conflictive with Batsch’s protologue because, in *Hebeloma* at least, a stipe decoration like the one described and illustrated for *A. subtestaceus* does not seem to be reasonably interpretable as remnants of velar structures.

Velar structures are generally referred to as universal and partial veils, but these terms cover structures which may be of very different origins and, therefore, not at all homologous



Fig. 1. *Agaricus subtestaceus* Batsch, illustration in Batsch (1789), *Elench. fung.*, cont. sec. (Halle): Tab. XXXV fig. 198. Image supplied courtesy of Centro Studi A.M.B.

(CLEMENÇON, 1997; 2004 and references therein). Unfortunately, for the genus *Hebeloma* there is not much information on the nature of such veils and the carpogenetic processes which determine them. Based on the information available (e. g. BRUCHET, 1973; BOEKHOUT, 1982; AANEN, 1999; VESTERHOLT, 1989; 2005), all species of this genus [excepting *H. radicosum* (Bull.: Fr.) Ricken] have a rather thin evanescent protective layer interpretable as a universal veil. In the species of *H. sect. Denudata* and *H. sect. Velutipes*, remains of such a veil can be observed, if at all, only very early in the developmental process between pileus margin and stipe with the help of a magnifying glass. In recent studies on *H. sect. Denudata* (VESTERHOLT & AL., 2014; EBERHARDT & AL., 2015) there is no mention of universal veil remains and in *H. sect. Velutipes* cottony-woolly patches can rarely be present at stipe base [e.g. *H. sinapizans* (Paulet) Gillet] or even more rarely along pileus margin (e.g. *H. bulbiferum* Maire), but only in young specimens (GRILLI & AL., in prep.). Also in species of *H. sect. Myxocybe* (Fayod) Konrad & Maubl. traces of universal veil may be visible in primordia or rarely as fibrillose remains along pileus margin and/or stipe suprmedian zone (e.g. *H. pumilum* J.E. Lange), but they are characterized by a more or less patently rooted stipe base. Finally, in *H. sect. Hebeloma* two veils are normally present: a woolly-fibrillose universal veil and a cortinate partial veil (VESTERHOLT, 1989; 2005). Remains of the first are generally visible along pileus margin and much more rarely over the lower stipe [e.g. *H. mesophaeum* (Fr.) Quél.]; remnants of the second can be observed as an arachnoid annular zone (cortina) close to the stipe apex (e.g. all members of *H. sect. Hebeloma*). In both cases the remnants are either in the form of woolly-fibrillose patches or cobweb-like girdles, never in the shape of erect flocci. Moreover, in the latter section, a fine pruina, due to the presence of caulocystidia, is confined to the portion of stipe between the lamellar attachment and the cortinate annulus, while the lower stipe is either smooth or fibrillose (BRUCHET, 1973).

As emphasized above, in Batsch's protologue, no velar remains are explicitly described, it is only reported that the stipe of *A. subtestaceus* is "*toto floccoso-hirto*". In the fig. 198a of the

plate XXXV, these flocci are difficult to discern as the stipe is of a relatively darker colour, but in the fig. 198b they are clearly represented as a fine pruinose decoration covering the whole stipe, just as is generally the case in members of *H. sect. Denudata* and *H. sect. Velutipes*. From the foregoing, it would seem reasonable to conclude that *A. subtestaceus* can be interpreted as a member of either sections, but with a strong preference for the second. A similar conclusion had already been reached by VESTERHOLT (1989), when he considered the possibility that it might be the same as *H. crustuliniforme* (Bull.) Quél., and VESTERHOLT (2005), when he cited *A. subtestaceus* Batsch, 1789 as putative synonym of *H. velutipes* Bruchet.

Unfortunately, without the recourse to microanatomy and sequence data, it is impossible to decide to which of the various members of such sections Batsch's species can be referred.

Interpretations of *Agaricus testaceus* Fr.

The interpretation of *A. testaceus* Fr. as a member of *H. section Hebeloma*, perfectly justified on account of its cortinate, flocculose-fibrillose stipe, was in wide currency among European mycologists during the past century and until the first years of the present century (COOKE, 1871 and 1881-1891; QUÉLET, 1872 and 1888; SACCARDO, 1877; BRESADOLA, 1930; LANGE, 1938; KONRAD & MAUBLANC, 1948; KÜHNER & ROMAGNESI, 1953; SINGER, 1962, 1975, 1986; BRUCHET, 1970; BOHUS, 1972; CETTO, 1976; MOSER, 1983; SMITH & AL., 1983; QUADRACCIA, 1984; VESTERHOLT & WEHOLT, 1985; KREISEL, 1987; BON, 2002), but it was LANGE (1938) who, providing a micro-anatomical description in which he specified that it has amygdaloid spores and ventricose cheilocystidia, offered a reliable morphological delimitation of the species and, therefore, strong grounds for the inclusion of the species in *H. sect. Hebeloma*.

Before Lange, RICKEN (1911) had also characterized *H. testaceum* as having amygdaliform spores (" $10-13 \times 6-7 \mu\text{m}$ "), but he described the cheilocystidia as filamentose-clavate (" $40-60 \times 6-10 \mu\text{m}$ "), which does not fit *H. sect. Hebeloma*. Most likely *H. testaceum* s. Ricken can be referred to one of the species now accommodated in *H. sect. Velutipes* indicated above. However, as far as we are aware, Ricken's view was not shared by any subsequent author.

Apart from Ricken, all the authors previous to Lange were either silent about microscopy (e.g. COOKE, 1871; QUÉLET, 1872) or were unclear about spore morphology. COOKE (1881-1891) only draws some spores, but it is difficult to decide whether they are ellipsoid or amygdaloid; QUÉLET (1888) describes them as "*pruniformes*", while BRESADOLA (1930), as "*ovato-amygdaliformes*" and draws them mostly as ellipsoid, which would make it a member of *Hebeloma* [sect. *Hebeloma*] subsect. *Hebeloma*.

LANGE'S (1938) delimitation of the species as being cortinate and amygdaloid-spored, and therefore a member of *Hebeloma* sect. *Hebeloma*, was followed by numerous authors, e. g. BRUCHET (1970), BOHUS (1972), CETTO (1976). SMITH & AL. (1983), QUADRACCIA (1984) and VESTERHOLT & WEHOLT (1985). However, VESTERHOLT (1989), who evidently regarded *A. subtestaceus* Batsch and *A. testaceus* Fr. as homotypic synonyms, considered Lange's interpretation to be in conflict with Batsch's protologue which, as discussed above, made no explicit mention or representation of universal or partial veil remains on the pileus margin or stipe. Vesterholt (1989) also regarded *A. subtestaceus* Batsch and *A. testaceus* Fr. as doubtful names and *H. testaceus* (Fr.) Quél. ss Lange as a misapplication for which he proposed the new species name *H. sordescens* Vesterh., this latter being designated as the type of *H. subsect. Amygdalina* Vesterh., published as a new subsection in the same paper. Excepting BON (2002) *H. testaceum* has not been used ever since (e.g. ARNOLDS & AL., 1995; BREITENBACH & KRÄNZLIN, 2000; MOSER & PEINTNER, 1985-2007; MOSER, 1992; ENDERLE, 2004; LEGON & HENRICI, 2005; VESTERHOLT, 2004, 2005, 2008).

It is to be noted that QUADRACCIA (1984: 30) had already erected *Hebeloma* subsect. *Testacea* Quadr. for the cortinate species with amygdaliform spores, with *Hebeloma testaceum* Quél. as type but with authorship erroneously cited as "(Batsch: Fr.) Quél.". If VESTERHOLT (1989)

had included *H. testaceum* (Fr.) Quél. in *H.* subsect. *Amygdalina* Vesterh., this would be an unpriorable synonym of *H.* subsect. *Testacea* Quadr., but he only included an interpretation of the taxon "*H. testaceum* [Fr.] Quél. sensu J.E. Lange" therefore excluding the type of *H. testaceum* Quél., so *H.* subsect. *Amygdalina* Vesterh. is legitimate. Erroneously, BON (2002) adopted *H.* subsect. *Testacea* Quadr. with type "*H. testaceum* s. Lange, Bruchet, *non al.* = *H. sordescens* Vesterh.", which is not possible as *H. sordescens* was not an original element of *H.* subsect. *Testacea* Quadr. 1984 because *H. sordescens* Vesterh. was published as a new species in 1989. The possible alternative interpretation of *A. testaceus* Fr., as an ellipsoid-spored species belonging in *H.* subsect. *Hebeloma*, cannot be ruled out completely. In this subsection, a not unlikely choice might be *H. sordidum* Maire, whose pileus, originally described as "ochre-roussâtre" (MAIRE, 1914), according to our experience, may exhibit a wide range of colours including that ("*testaceo-pallens*") described by Fries. An example is the *H. testaceum* of Bresadola's plate 707 which, in all likelihood, may be referred to Maire's species. [See SINGER (1961): "[t]he *H. testaceum* in the sense of Bresadola seems to be the same as *Hebeloma fastibile* sensu Konrad, Kühner & Romagnesi (*non Persoon*)", that is to say what is now referred to as *H. sordidum*]. Also the North American *H. lateritium* Murrill (≡ *H. mesophaeum* var. *lateritium* (Murrill) A.H. Sm., V.S. Evenson & Mitchel) could match, but this species is hardly separable from *H. mesophaeum*, at least on morphological grounds (GRILLI, 2009), and in the case it were different it might not be present in Europe.

Finally, if it can reasonably be excluded that the evelate specimens depicted in Fries' plate of *Agaricus* (*Hebeloma*) *testaceum* Batsch housed at S (see fig 2) do belong to *H.* sect. *Hebeloma* it is also difficult to ascribe them with any certainty to some of the species of *H.* sect. *Velutipes* cited above. They might even represent *H. theobrominum* Quadr.

Nomenclatural situation of *A. subtestaceus* Batsch and *A. testaceus* Fr.

Agaricus subtestaceus Batsch, *Elench. Fung.*, cont. sec. (Halle): 39. 1789

≡ *Hebeloma subtestaceum* (Batsch) Bres. & Sacc. *Malpighia* XI: 247. 1897

– *Hebeloma subtestaceum* (Batsch) Kuyper, *Persoonia*, suppl. vol. 3: 236, 1986. [a later isonym of *Hebeloma subtestaceum* (Batsch) Bres. & Sacc. without nomenclatural status; Art. 6. 3, Note 2]

Note: VESTERHOLT (1989) and Mycobank consider *Hebeloma subtestaceum* (Batsch) Kuyper an illegitimate name being a later homonym of *H. subtestaceum* Murrill, *N. Amer. Fl.* 10(3): 226 (1917) that they consider as legitimate. However, this is not correct as *H. subtestaceum* Murrill is a later homonym of *H. subtestaceum* (Batsch) Bres. & Sacc. and therefore illegitimate according to Art. 53.1.

So, the name *Hebeloma subtestaceum* (Batsch) Bres. & Sacc. would be available in *Hebeloma*.

Mycobank: MB812259.

Agaricus testaceus Fr., *Epicr. Syst. Mycol.*: 178. 1838. [nom. illeg., Art. 53.1]

≡ *Hebeloma testaceum* Quél., *Mém. Soc. Emul. Montbéliard*, II, 5: 250. 1872

A. testaceus Fr. is an illegitimate name under Art. 53.1, as it is a later homonym of *A. testaceus* Scop. [*Fl. carniol.*, Ed. 2, 2: 453 (no. 1558) (1772)]. However, under Art. 58.1 *H. testaceum* Quél. is a legitimate name and is available in *Hebeloma*.

H. testaceum could be homotypic or heterotypic with *H. subtestaceum* depending on the type designated for the latter. In the protologue of *A. subtestaceus* there are both specimens and illustrations which can be designated as lectotypes. Batsch mentions two syntypes ("*sylvulam* Forst initio october 1788" and "*monte Jenzig* initio october 1788"). In addition to these two syntypes, Batsch also includes three figures (198a, 198b and 198c) in the plate XXXV which can be designated as lectotype, if no material on which Batsch based his description is extant. It is impossible to establish a correspondence between the syntypes and the figures, but it seems that the figures 198b and 198c depict the same basidiome, judging from Batsch's caption



Fig. 2. *Agaricus testaceus* Fr., Fries' original unpublished color plate housed at the Swedish Museum of Natural History (S) as *Agaricus (Hebeloma) testaceus* Batsch. Image supplied courtesy of A. Anderberg, M. Ehn and J. Klackenborg. © Naturhistoriska riksmuseet, Stockholm.

to fig. 198c (“idem dissectus”). According to H.J. ZÜNDORF (pers. comm.), no specimens of *A. subtetaceus* exist at JE, the herbarium where, according to TL-2 (SI Website), Batsch’s material is deposited.

As stated above, *Hebeloma subtetaceum* is available in *Hebeloma*. If the same type is designated for *A. subtetaceus* Batsch and *A. tetaceus* Fr., which automatically would be also the type of *H. tetaceum* Qué., we would have only one name with two homotypic synonyms: *A. subtetaceus* Batsch and *A. tetaceus* Fr. and a unique concept of the taxon. In this case, if both Fries’ and Quélet’s interpretations of *A. tetaceus* as a cortinate species are considered to be in conflict with the protologue, they would also be misapplications which, however, would not affect the name *H. tetaceum* Qué. whose type, concept and circumscription would be that of *Agaricus subtetaceus*.

Given the above situation, we:

a.- designate the same type for *Agaricus subtetaceus* Batsch and *A. tetaceus* Fr., and therefore we have only one correct name: *Hebeloma subtetaceum* (Batsch) Bres. & Sacc.

Hebeloma subtetaceum (Batsch) Bres. & Sacc. Malpighia XI: 247. 1897

≡ *Agaricus subtetaceus* Batsch, *Elench. Fung.*, cont. sec. (Halle): 39. 1789 [basonym]

≡ *Agaricus tetaceus* Fr., *Epicr. Syst. Mycol.*: 178. 1838. [nom. illeg.]

≡ *Hebeloma tetaceum* Qué., *Mém. Soc. Emul. Montbéliard*, II, 5: 250. 1872

Agaricus subtetaceus Batsch, *Elench. Fung.*, cont. sec. (Halle): 39. 1789

Lectotypus (hic designatus): [icon] *Agaricus subtetaceus* in Batsch, *Elench. Fung.*, cont. sec. (Halle): Tab. XXXV figure 198. 1789. Mycobank: MBT201175

Agaricus tetaceus Fr., *Epicr. Syst. Mycol.*: 178. 1838

Lectotypus (hic designatus): [icon] *Agaricus subtetaceus* in Batsch, *Elench. Fung.*, cont. sec. (Halle): Tab. XXXV figure 198. 1789. Mycobank: MBT201176

b.- consider the name *Hebeloma subtetaceum* as doubtful as it can be applied to several present taxa, and cannot be unambiguously assigned to any modern species of the genus *Hebeloma*. Old names unless unanimously (or almost unanimously) interpreted are very difficult to assign to present taxa without conflict.

Conclusions

Given the nomenclatural situation of *A. subtetaceus* Batsch and *A. tetaceus* Fr. and the fact that the latter was historically interpreted as referring to one or more members of *H. sect. Hebeloma*, while the former can, more appropriately (see discussion above), be referred to several members of *H. sect. Velutipes*, given also the absence of any original specimen of *A. subtetaceus* at JE, that of any original specimen of *A. tetaceus* at UPS, (S. EKMAN pers. comm.) and that Fries’ plate of *A. tetaceus* adds only to confusion, our conclusion must be that we cannot unambiguously determine the identity of both taxa.

In summary, with a view to preserving nomenclatural stability, the only satisfactory solution is to designate Batsch’s figure 198 as lectotype of *A. subtetaceus* Batsch and *A. tetaceus* Fr., which conforms with both protologues and to regard Batsch’s name as doubtful and use for each of the taxa that this might represent a modern name for which there is a type specimen, a complete description and also a molecular characterization.

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