Climacodon pulcherrimus a badly known tropical species, present in Europe

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Abstract – Climacodon pulcherrimus, a polymorphous species with a large distribution and habitat, is described macro- and microscopically. Its uncertain taxonomic position has led to the description of many synonymous species and placement in different genera. The type species of Hydnum pulcherrimum Berk. & M.A. Curtis is examined for the first time and it is compared with other collections from Malay Peninsula, Pakistan, USA and Spain. The study of Spanish collections enlarges the distribution to the South of Europe.

Basidiomycota / Meruliaceae / Climacodon / Donkia / Hydnum / systematics / chorology / taxonomy

INTRODUCTION

In the last four years, we have collected some basidiomata of a saprophyte fungus with a basidioma of medium size, normally dimidiate with trametoid appearance and hydnoid hymenophore. Microscopically it is characterized by the presence of double or multiple clamp connections, ellipsoid basidiospores and absence of cystidia. Finally, we could determine it, with some difficulties, as a member of the genus Climacodon P. Karst., belonging to the family Meruliaceae P. Karst., order Polyporales Gāum. (Kirk et al., 2001). This genus includes species with conspicuous cystidia and hyphae with single clamp connections, with the only exception of C. pulcherrimus (Berk. & M.A. Curtis) M.I. Nikol., collected by us. For these reasons its inclusion in Climacodon is very conflictive and its taxonomic insertion is very difficult.

Climacodon pulcherrimus is a polymorphous species with a wide distribution and habitat, therefore there are many descriptions under different names which were synonymized by Maas Geesteranus (1971). Hydnum pulcherrimum Berk & M.A. Curtis, basonym of Climacodon pulcherrimus, has been characterized depending on the differing interpretations. According to Maas Geesteranus (1971) it has gloecystidia that sometimes are not developed and

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double or multiple clamp connections. Pilát (1936) described it with leptocystidia without any reference to the presence of clamp connections. Recently, Gibertoni et al. (2004) has commented on the presence of gloecystidia but provides no information about the characteristics of clamp connections.

On the other hand, Hydnum pulcherrimum has been recombined into such genera as Steccherinum, Creolophus, Dryodon and Donkia, but has not been included in Phanerochaete, although it shares some characters with this genus (Nakasone, 1990).

The above comments indicate the necessity to study the type material of Hydnum pulcherrimum deposited in the herbarium K, and not studied by Maas Geesteranus (1971), in order to clarify the taxonomic problems.

The study of Spanish collections has enlarged the distribution to the South of Europe.

MATERIAL AND METHODS

The specimens examined are kept in the following herbaria: AH, ARAN-Fungi, BIO-Fungi, K. L, UPS and Lloyd Mycological collection in BPI.

The material collected was studied with a binocular microscope and after mounting in KOH 5% and ammoniacal Congo red solution. Spore measurements were made under the oil immersion objective. The micrographs have been made with a Nikon (Eclipse 80i) microscope and a digital camera Nikon (DS-5M).

The abbreviations for author citations follow Kirk & Ansell (2003).

TAXONOMY

≡ Creolophus pulcherrimus (Berk. & M.A. Curtis) Banker, Mycologia 5(6): 294 (1913)
≡ Donkia pulcherrima (Berk. & M.A. Curtis) Pilát, Bull. trimest. Soc. mycol. Fr. 52(3): 328 (1936)
≡ Hydnum uleanum Henn., Hedwigia 36: 198 (1897)
≡ Hydnum kauffmani Peck [as “kauffmani”], Bull. Torrey bot. Club 34: 348 (1907)
≡ Hydnum australe Lloyd, Mycol. Writ. 5 (Letter 69): 11 (1919)
≡ Hydnum duriusculum Lloyd, Mycol. Writ. 7: 1107 (1922)

*Climacodon pulcherrimus* a budly known tropical species, present in Europe

Figs. 1-11 *Climacodon pulcherrimus* AH 31379. 1-3: Contextual hyphae. 4-5. Hyphae of the pileipellis. 6-7: Hyphae of the subhymenium. 8: Detail of the hymenium. 9-10: Basidia. 11: Spores.

Basidiocarps solitary, often imbricated, 3.5-11 × 2-6 cm, broadly attached to the substrate, dimidiate, semicircular, flattened, up to triangular in section, upper surface pale brownish with orange or orange-reddish tints, tomentose, azonate, margin concolorous. Hymenophore hydroid, orange-cream to pale orange brown, sometimes with carmelized aspect in herbarium material, teeth up to 6 × 1 mm, joined at the base, cylindrical to somewhat flattened, with acute ends without branches, sometimes slightly ciliate or tuberculate. Context white to brownish, soft, 2-5 mm. Smell scarcely notable. Flavour to fungi hardly relevant.

Hyphal system monomitic; contextual hyphae hyaline, thin to thick walled, 4-6-(-8) µm, septate, occasionally branched, afibrate or with 1-2(-5) clamp in each septum. Hyphae of the pileipellis 7-9 µm diameter, double walled, hyaline, sometimes with oily content, septate, afibrate or with 1-2-3-4 (-5) clamp in each septum. Hyphae of the trama of the teeth 3-4 µm diameter, parallel, septate, hyaline, sometimes with abundant oil drops, without or with very scanty clamps. Hyphae of the subhymenium 2.5-3 µm, with prismatic texture, without clamps. Basidia (15-)20-30 × 4-4.5 µm, subclavate to cylindrical, hyaline, thin walled, tetrasporic, without clampsthe base. Cystidia lacking, with some hyphal ends with obtuse apex, projecting from the hymenium which are visible with stereoscopic microscopy, giving a velutinous appearance. Basidiospores 4-5(-6) × 1.5-2(-2.5) µm, ellipsoid to allantoid, hyaline, smooth, thin walled, non-amyloid, non-dextrinoid. Oil drops are very common in the hymenophore, mainly in the trama.

STUDY OF THE TYPE MATERIAL

The type material of Hydnum pulcherrimum Berk. & M.A. Curtis is conserved inside of a brown envelope, that is kept in a brownish pack labelled as K(M) 135348 (Fig. 12-13). This material consists of remains of a basidioma.
Climacodon pulcherrimus a budly known tropical species, present in Europe


fragmented in three portions (Fig. 14). The smallest portion is affixed to a pasteboard and it is possible to observe the hydnoid hymenophore in it (Fig. 15). The second portion is crushed, of approx. 2.5 × 1.5 cm and the largest is approx 5 × 3 cm and is also crushed.

Description. – Basidioma strawy cream coloured, fibrous; hymenophore hydnoid, teeth orangish brown, approx. 2 mm long. Hyphal system monomitic. Hyphae of the pileipellis hyaline, septate, double walled, 7-10 μm diam., 1-2-3-4 clamp connections in each septum or rarely afibulate (Figs. 16-17). Hymenophore
composed by very collapsed hyphae, difficult to see in ammoniac Congo red solution and KOH 5%. Hyphae of the trama of the teeth cylindrical and narrow, 2.5-4 μm diam. Spores hyaline, small and very collapsed, making it difficult to observe their morphology and size.

The type material of *Hydnum duriusculeum* from Singapore is conserved in BPI US0324672 (type), in the same packet there is another collection with number BPI US0324671. Both collections are in a bad condition, due to the treatment with mercury chloride and it has been impossible to do the macro and microscopic study. This problem has already been indicated by Maas Geesteranus in a revision label dated to 1969. Only in BPI US0324672, labelled as type, we have been able to see the hydnoeid aspect of the hymenophore.
DISCUSSION

This species is characterized by the diminutive basidiocarp, irpicoid, with orange tint, hyphae of the pileipellis and the trama with 2-3-4 clamps, many oil drops in the trama of the hymenophore, lacking cystidia, although sometimes it is possible to observe some hyphal ends in the hymenium and small and hyaline spores (4-5 × 1.5-2 μm), ellipsoid to allantoid.

In the point 9 of the key of the monograph of Maas Geesteranus (1971) on the hydnaceous fungi, the presence of cystidia points to *Climacodon*, but in the description of *Climacodon pulcherrimus* (p. 140) the following description is given: “Gloeocystidia 2.7-4.5 μm wide, projecting but little beyond the basidia, thin-walled to thick-walled, not encrusted, sometimes not developed”. In our observations, we have seen no cystidia, neither in type material of *Hydnum pulcherrimus* and due to this fact, it is very difficult to determine *Climacodon pulcherrimus* using this paper.

The genus *Climacodon* was created by Karsten (1881) based in the type species *Hydnum septentrionale* Fr., which has thick-walled cystidia, often with encrusted tips and hyphae, never with more than one clamp connections per septum (Maas Geesteranus, 1971).

Pilát (1933) recombined *Hydnum pulcherrimus* to *Dryodon pulcherrimus* and described the material collected from Siberia on *Fagus sylvatica, Betula verrucosa, Abies sibirica* and *Populus tremula*, with thin-walled and cylindrical cystidia (38-35 × 3-3.5 μm) projecting 15 μm above the hymenium. We have not observed these cystidia in the Iberian material and nothing in the type of *Hydnum pulcherrimus*. This author does not comment on the presence or absence of clamp connections.

Later Pilát (1936) created the genus *Donkia* for this species with the following Latin diagnosis “Genus ex affinitate generis Dryodon a quo deficientia gloeocystidarum in hymenio membranaque sporarum haud amyloidea discrepat. Inter genera Mycoleptodon et Dryodon genus intermedium. Carposomata effusoreflexa vel laterilater adnata, lignicola, in latere inferiori aculeos fertita. Hymenium solum e basidiis compositum vel solum cystidiola basidiformia, plus minus vacua adsunt. Sporae hyalinae, ovatae vel ellipsoideae, membrana laevi vi solutionis jodi haud coerulescenti instructae”. As it is possible to see, Pilát described the presence of cystidia basidiformia, absence of gloeocystidia and he did not indicate the presence of clamp connections. We agree with Pilát in the absence of gloeocystidia in the material revised by us, however we have not observed cystidia basidiformia drawn and described by him.

Nakasone (1990) treats this species as *Donkia pulcherrima* and has made cultures with material collected on diverse species of *Quercus* (*Q. virginiana, Q. nigra, Q. phellos, Q. sp.*) and *Abies* sp. from different states of U.S.A. In this paper, the morphological characters are described and he stressed the white rot character, as previously commented by Gilbertson et al. (1975). Nakasone indicates that culturally *D. pulcherrima* resembles some *Phanerochaete P. Karst.* species and he mentions the presence of double or multiple clamp connections in the mycelia of the cultures, as also occurs in *P. burtii* (Romell ex Burt) Parmasto, *P. crassa* (Lév.) Burds., *P. ericina* (Bourdot) J. Erikss. & Ryvarden (now *Peniophora ericina*), *P. exilis* (Burt) Burds., *P. flavoalba* (Cooke) S.S. Rattan, *P. gigantea* (Fr.) S.S. Rattan (now *Phlebiopsis gigantea*), *P. laevis* (Fr.) J. Erikss. & Ryvarden, *P. rimoso* (Cooke) Burds. (now *Scopuloïdes rimoso*). Burdsall (1985)
cites 13 species of *Phanerochaete* whose subicular hyphae have double or multiple clamp connections.

We sent a portion of the Iberian material before placing it in *Climacodon pulcherrimus*, to Dr. Larsson to do molecular biology studies. He answered us (com. pers.): “the most similar sequences from our dataset represent monomitic, non-clamped species like *Phanerochaete* spp. and *Phlebia deflectens*. It points in a certain direction but does not give enough guidance for a decision about generic placement”.

We conclude that the insertion of *Climacodon pulcherrimus* in this genus is inappropriate, due to the presence (only in this species of *Climacodon*) of hyphae with double or multiple clamp connections and the absence of cystidia in the studied material. Also, this species share cultural and molecular characteristics with the genus *Phanerochaete*, so perhaps it must be placed again in the genus *Donkia* or included in the genus *Phanerochaete*.

Other closely related genera are *Odonticum* and *Spongipellis*.

*Odonticum* differs because of its resupinate basidiocarps and the total absence of fibulae, but shares the type of hymenophore with teeth that are fused at the base, absence of cystidia and basidiospores of small dimensions.

*Spongipellis* has dimidiate fructifications with pores. An exception is *S. pachyodon* (Pers.) Kotl. & Pouz., that has a hydnoid hymenophore. However, it differs because one of the characters of the genus is the presence of fibulae in all the septae.

*Climacodon pulcherrimus* has a tropical distribution, it is known from Asia: Japan, Java, Pakistan, Peninsula Malaysia, Philippines, Sikkim and Thailand (Pilát, 1936; Maas Geesteranus, 1971). In Europe it is known only from France (Candousseau, 1981) and Russia (Pilát, 1933, 1936) and recently from Northern Spain (Salcedo et al., 2006). In America it has been cited by Bononi (1979) and Gibertoni et al. (2004) from Brazil, but they indicate the presence of gloeccystidia, dimitic hyphal structure and mention nothing about hyphae having multiple clamp connections in the pileipellis. We have revised this material and find it to be monomitic, and find that it has fibulae only in the generative hyphae with 2-3-4 clamps in the context.

Nakasone (1990) and Gilbertson et al. (1975) cited this species from U.S.A.

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REFERENCES


