

## ***Chroogomphus ochraceus* (Kauffman) O.K. Mill., the correct name for *Chroogomphus fulmineus* (R. Heim) Courtec.**

M. VILLARREAL & M. HEYKOOP

Dpto. de Biología Vegetal (Botánica), Univ. de Alcalá  
E- 28871 Alcalá de Henares, Madrid.

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Key words: *Chroogomphus*, *Gomphidiaceae*, *Boletales*, *Agaricales s.l.*, taxonomy.

Summary: A thorough taxonomical study based on material of *Chroogomphus ochraceus* (Kauffman) O.K. Mill., *C. fulmineus* (R. Heim) Courtec. and *C. rutilus* (Schaeff.: Fr.) O.K. Mill., coming from North America and Europe, has been realized in order to elucidate the exact circumscription of these taxa. We conclude that the two first taxa must be treated as synonyms, as they do not present any substantial morphological differences, and, consequently, the correct name for the European records of *C. fulmineus* is *C. ochraceus*. On the other hand, *C. ochraceus* differs clearly from *C. rutilus* both from a macroscopical and microscopical point of view. Microphotographs of the differences of both taxa are provided, and, besides, *C. ochraceus* is illustrated macroscopically and microscopically.

Zusammenfassung: Es wurde eine gründliche taxonomische Studie durchgeführt, basierend auf Material von *Chroogomphus ochraceus* (Kauffman) O.K. Mill., *C. fulmineus* (R. Heim) Courtec. and *C. rutilus* (Schaeff.: Fr.) O.K. Mill. aus Nordamerika und Europa, um die genaue Umgrenzung dieser Taxa zu beleuchten. Wir schließen, daß die beiden erstgenannten Taxa als Synonyme zu behandeln sind, da sie keinerlei wesentliche morphologische Unterschiede zeigen; der korrekte Name für europäische Nachweise von *C. fulmineus* ist folglich *C. ochraceus*. Andererseits unterscheidet sich *C. ochraceus* sowohl in makroskopischer als auch mikroskopischer Hinsicht deutlich von *C. rutilus*. Die Unterschiede beider Taxa werden anhand von Mikrofotos dargestellt, *C. ochraceus* ist darüber hinaus makroskopisch wie mikroskopisch illustriert.

### **Introduction**

During the autumn-winter period of 1995 we have collected repeatedly, in Ávila (Spain), a very distinctive species of the genus *Chroogomphus* (Singer) O.K. Mill. which differs clearly macroscopically from *C. rutilus* (Schaeff.: Fr.) O.K. Mill. After a thorough macro- and microscopical study, and according to the available literature on this genus (MURRILL 1912; KAUFFMAN 1925; SINGER 1946, 1949; MILLER 1964, 1966; MILLER & WATLING 1970; WATLING 1967; MILLER & TRAPPE 1970; SINGER & KUTHAN 1976; KHAN & HORA 1978; THIERS 1985), we conclude that our material fits perfectly into the concept of *Chroogomphus ochraceus* (Kauffman) O.K. Mill., a taxon which has not been recorded up to date in Europe under this name. However, all records of *Chroogomphus rutilus* var. *fulmineus* (R. Heim) Courtec. and *C. fulmineus* (R. Heim) Courtec.

must be considered to be indicative of the distribution of *C. ochraceus* in our continent since it became evident, after a revision of typical material of the former (kindly lent to us by Dr. Courtecuisse), that both taxa are conspecific.

The taxonomic status of *Chroogomphus ochraceus* (Kauffman) O.K. Mill. has been somewhat controversial and has changed repeatedly during the last years. So, *Gomphidius ochraceus* was described originally from Oregon - North America - (KAUFFMAN 1925). Later, HEIM (1934) described *Gomphidius viscidus* var. *fulmineus* from Catalonia - Spain - as a new variety, differing from *G. viscidus*, according to him, because of its small size, fruitbodies with bright orange to apricot tinges, and the context which turns pinkish when cut. SINGER (1946) proposed the new combination *Gomphidius rutilus* var. *fulmineus* (R. Heim) Singer and admitted the possibility that the latter could represent a species in its own right. Later, MILLER (1964) synonymized this taxon with *Chroogomphus ochraceus* basing this statement, erroneously, on a description supposedly realized by MAIRE et al. (1933); nevertheless, no description of this taxon can be found in the latter paper. SINGER & KUTHAN (1976) even pointed the possibility that the fungus described by HEIM (1934) could be the same as *C. helveticus* ssp. *tatrensis*, remaining doubtful, however, because of the absence in the latter description of such important characters as the colour of the dried mycelium, the habitat and the amyloidity of the epicutis. On the other hand, COURTECUISE (1986) and SINGER (1986) proposed, respectively, the new combinations *Chroogomphus rutilus* var. *fulmineus* (R. Heim) Courtec. and *Chroogomphus ochraceus* (Kauffman) O.K. Mill. ssp. *fulmineus* (R. Heim) Singer. Finally, COURTECUISE (1988) elevated the rank of this taxon to the specific level.

***Chroogomphus ochraceus* (Kauffman) O.K. Mill.**, Mycologia 56: 546 (1964).

Figs. (1-3, 4a-b and 4d)

- ≡ *Gomphidius ochraceus* Kauffman, Mycologia 17: 119 (1925)
- = *Gomphidius viscidus* var. *fulmineus* R. Heim, Treb. Mus. Cienc. Nat. Barcelona 15: 68 (1934)
- = *Gomphidius rutilus* var. *fulmineus* (R. Heim) Singer, Farlowia 2: 534 (1946)
- = *Chroogomphus rutilus* var. *fulmineus* (R. Heim) Courtec., Doc. Mycol. 16(62): 6 (1986)
- = *Chroogomphus ochraceus* (Kauffman) O.K. Mill. ssp. *fulmineus* (R. Heim) Singer, The Agaricales in Modern Taxonomy p.736. (1986)
- = *Chroogomphus fulmineus* (R. Heim) Courtec., Doc. Mycol. 18 (72): 50 (1988)

**Selected descriptions:** SINGER (1949), MILLER (1964), THIERS (1985).

**Selected illustrations:** COURTECUISE & DUHEM (1994).

**Material studied:** USA- Kauffman (Holotype) 22-IX-1922, MICH lacking number; Green Lake, Mt. Rainier National Park, Pierce Co. (WA), 2-X-1952 MICH 40478; Saginaw Forest, Ann Arbor, Washtenaw Co. (MI), under pine, 7-X-1936, MICH 5053. SPAIN- Casavieja (Ávila), under *Pinus pinaster*, 5-XI-1995, M. Villarreal & M. A. Jiménez, AH 20458; Casavieja (Ávila), under *Pinus pinaster*, M. Villarreal & M. A. Jiménez, 19-XI-1995, AH 20459; Casavieja (Ávila), under *Pinus pinaster*, M. Heykoop, S.G. Busutil, C. Sánchez & M. Villarreal, 23-XI-1995, AH 20460; Casavieja (Ávila), under *Pinus pinaster*, M. Villarreal & M. A. Jiménez, 24-XII-1995, AH 20461; Casavieja (Ávila), under *Pinus pinaster*, M. Villarreal & M. A. Jiménez, 31-XII-1995, AH 20462. FRANCE- Mont Aigu, Marne, under *Pinus laricio* and birch on calcareous soil, Courtecuisse, Priv. Herb. Courtecuisse 84.10.05.01; Ste. Marguerite, Loire-Atlantique, Env. St. Nazaire, under *Pinus* and *Quercus ilex* on sand, 13-12-85, Courtecuisse, Priou & Halet, Priv. Herb. Courtecuisse 85061.

**Other material examined:** (Chroogomphus rutilus) SPAIN- Umbría de Siete Picos, Valsain (Segovia), F. Pando, under *Pinus sylvestris*, 24-X-1984, AH 3730. Los Cotos (Madrid), G. López & G. Moreno, under *P. sylvestris* and *Betula celtiberica*, 15-IX-1975, AH 12.416. Between Peralejos de las Truchas and Laguna de Taravilla (Guadalajara), M. Heykoop & J. Álvarez, under *P. nigra* ssp. *salzmannii*, 7-XI-1991, AH 14158.

Pileus 1.5–4.5 (7.5) cm in diam., hemispherical to conical in young specimens, convex at maturity, even slightly depressed in those very mature specimens, rarely umbonate. Margin inflexed when young, thick and slightly exceeding, then deflexed to straight, concolorous or subconcolorous with the cuticle, with abundant and fugacious rests of orange veil on young specimens. Cuticle viscid, though not glutinous, smooth, shiny, not easily detachable, at first orange-yellow to orange, then orange-reddish, apricot, turning vinaceous at maturity. Context orange-yellow to orange-ochraceous, slowly turning orange-red or red, especially towards the base of stipe and under the cuticle. Gills crowded to subdistant, decurrent, arcuate, dull orange to salmon, later orange-ochraceous (sometimes with reddish tinges), finally dark vinaceous, with concolorous entire lamella edge, sometimes forked; lamellulae present (one between each pair of gills). Stipe 3–7.5 x 0.5–1.8 cm, cylindrical, flexuose, full, base prolonged in a root in some specimens, concolorous with pileus or turning reddish, especially at the base, with abundant rests of orange-reddish to ochraceous-blackish cortina in the very upper part. Fruitbodies bright vinaceous when dry. Mycelium at the base of stipe pink-orange, becoming clearly pinkish as it dries out. Smell not distinctive. Taste not distinctive or slightly sweetish. Spore print brown-olivaceous. **Chemical tests:** context pinkish to purple with KOH and NH<sub>4</sub>OH; grey-greenish with FeSO<sub>4</sub>; no reaction with sulphovanillin.

Spores subfusiform in frontal view, ellipsoid in side view, with a clear suprahilar depression, pale brown to subhyaline in KOH, slightly dextrinoid, thin-walled (up to 1 µm); **size:**

- (17)17.3–**19.64**–21.5 x (6)6.2–**6.81**–7.2 µm; Q= 2.57–**2.88**–3.31 (n=22) (AH 20460).
- (16)16.3–**18.51**–20.7(21) x 6.2–**6.63**–7 µm; Q= 2.46–**2.80**–3.15 (n=23) (HOLOTYPE Kauffman).
- (15) 15.4–**17.18**–18.2 x 6–**6.40**–7.2(7.5) µm; Q= (2.24)2.33–**2.69**–2.92 (n=23) (MICH 40478).
- 16–**17.79**–19 x 6–**6.73**–7.4(7.5) µm; Q= (2.28)2.34–**2.64**–2.92 (n=23) (MICH 5053).
- (17)17.2–**18.52**–19.5 x 6–**6.68**–7.4(7.5) µm; Q= (2.36)2.42–**2.78**–3.14(3.17) (n=23) (Priv. Herb. Courtec. 84.10.05.01).
- 18.5–**20.75**–23 x 6.2–**7.06**–7.5 µm; Q= 2.57–**2.95**–3.36(3.47) (n=23) (Priv. Herb. Courtec. 85061).

Basidia 41–60 x 9–13 µm, clavate, with sterigmata up to 5 µm, hyaline or with yellow-brown vacuolar content, walls inamyloid or very faintly amyloid. Cheilocystidia and pleurocystidia abundant, 100–187 x 14–19 µm, narrowly clavate, cylindrical to sublageniform, sometimes with subcapitate apex, generally thin-walled (sometimes up to 2 µm), inamyloid, hyaline, with purple-brown to ochraceous resinous incrustations, the amount and location however being very variable. This resinous matter dissolves partially when fresh material is mounted in Melzer's reagent (the latter does not happen with dried material). Hymenophoral trama consisting of cylindrical hyphae, 3–16 µm in diam., a large number being amyloid, especially in the subhymenium. Pileocystidia not observed (only some obtuse cylindrical hyphae apices). Pileipellis an ixocutis formed by cylindrical hyphae, 3.5–8 µm in diam., hyaline or with yellow-brown intracellular content when mounted in KOH, with resinous incrustations similar to those of hymenium, the majority inamyloid, but some of them with clearly amyloid walls (Figs. 4a-b and 4c). Veil consisting of cylindrical hyphae, 2–7(9) µm in diam., hyaline in KOH, strongly amyloid and with abundant incrustations. Pileitrama strongly amyloid. Clamp connections absent in all parts of basidiocarp except for some hyphae of the basal mycelium.

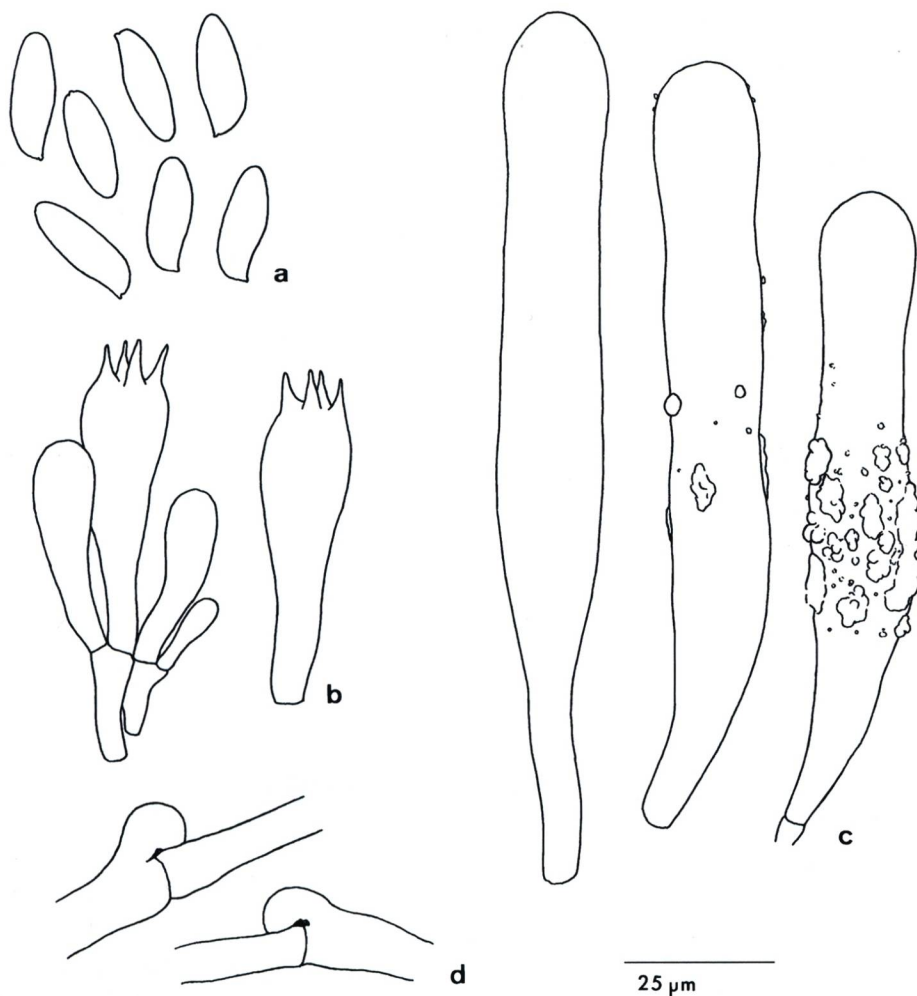
**Habitat:** On soil, isolated or in small groups, very abundant in the studied area, occurring under *Pinus pinaster*, on acid soil. Fruiting from the end of October till the end of December.



**Fig. 1:** *Chroogomphus ochraceus* (Kauffman) O.K. Mill., AH 20460 (dia: M. Heykoop)



**Fig. 2:** *Chroogomphus ochraceus* (Kauffman) O.K. Mill., AH 20462 (dia: M. Villarreal)

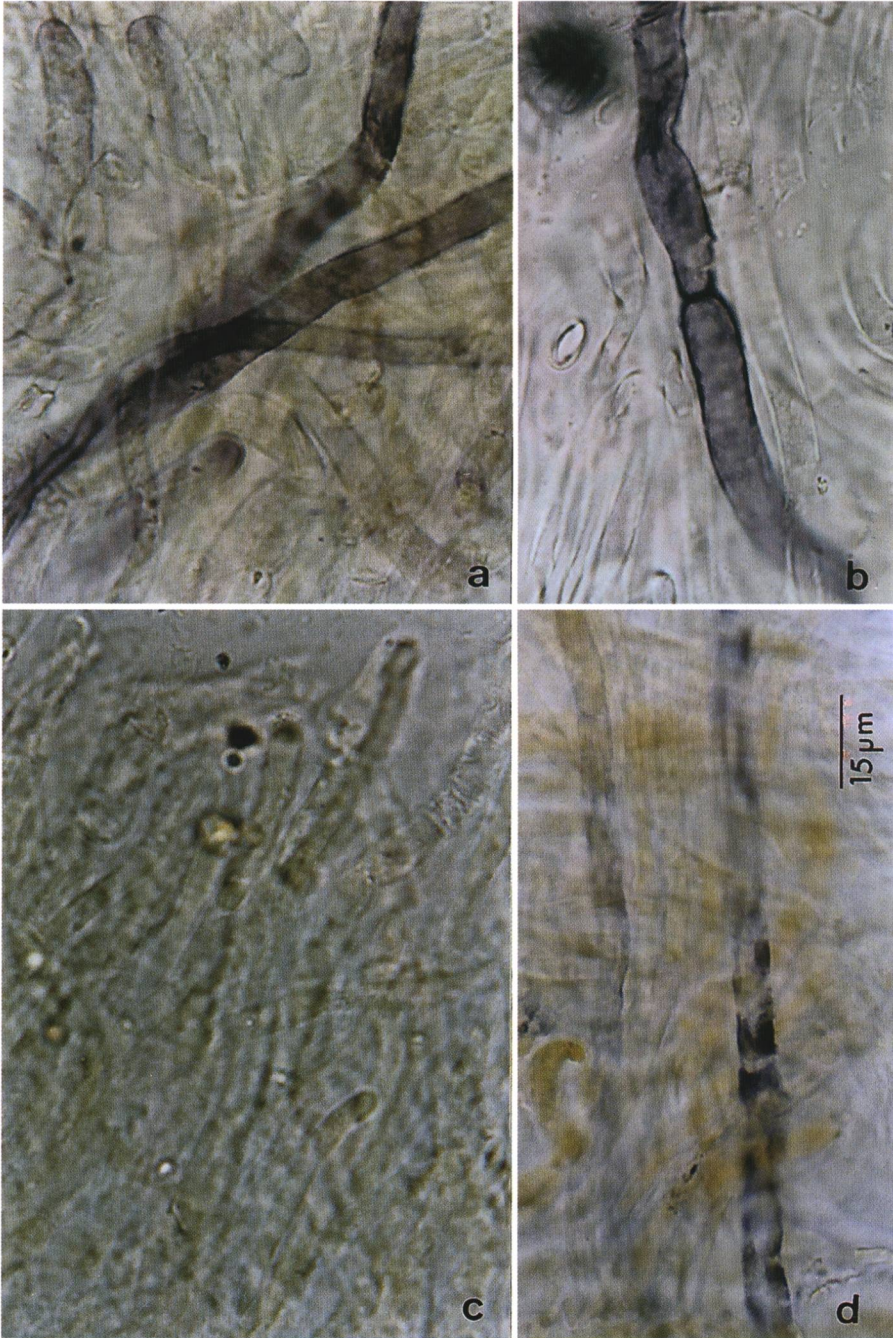


**Fig. 3:** *Chroogomphus ochraceus* (Kauffman) O.K. Mill., AH 20460; a: spores; b: basidia; c: hymenial cystidia; d: hyphae of basal mycelium with clamps.

### Discussion

*Chroogomphus ochraceus* probably represents a widely distributed fungus in Europe, and we think that it possibly has been mistaken for *C. rutilus*. So, one of us (M.H.) has observed it in 1994 in a mycological exposition in Zaragoza (Spain) under the erroneous name of *C. rutilus*. On the other hand, CASTRO CERCEDA (pers. com.) has observed it repeatedly and very abundantly in Galicia (Spain). Furthermore, COURTECUISE & DUHEM (1994) indicate that this taxon (under the name of *C. fulmineus*) is distributed in France, Italy and Spain.

*Chroogomphus ochraceus* and *C. rutilus* are closely related, both belonging to section *Chroogomphus* (= *Viscigomphus* S. Imai emend. Singer). Nevertheless, they are easily distinguished macroscopically since *C. ochraceus* differs from *C. rutilus* because of the typical bright colours



**Fig. 4:** a: pileipellis of *Chroogomphus rutilus* var. *fulmineus* (R. Heim) Courtec., priv. herb. Courtec. 85061; b: pileipellis of *Chroogomphus ochraceus* (Kauffman) O.K. Mill., AH 20460; c: pileipellis of *Chroogomphus rutilus* (Schaeff.: Fr.) O.K. Mill., AH 3730; d: pileipellis of *Gomphidius ochraceus* Kauffman, Holotype (Barr = 15 µm).

of the pileus and stipe, which range from orange-ochraceous to apricot, the very small umbo (which may be absent), the dried pinkish mycelium and the abundant rests of veil at the margin of the immature specimens. Besides, the pinkish to purplish -and not violet as in *C. rutilus*-reactions of the context with KOH and NH<sub>4</sub>OH clearly separates it from the latter.

In contrast to their macroscopic features, the microscopical characters of both species are very similar; neither their sporal parameters nor the location, abundance or colour of the cystidia's incrustations show any significant differences. We agree with KAUFFMAN (1925), who stated that the latter character cannot be used at the specific level as it is ephemeral and depends on the developmental conditions, as well as on the age of the material studied, which in old specimens frequently presents collapsed cystidia. As for the thickness of the walls of these cystidia, both species are thin-walled; only in one collection (MICH 40478) we could find some cystidia with thicker walls, but never more than 2 µm. We have not observed any cystidia with amyloid walls (not even in MICH 40478), despite the fact that the latter collection included some brief annotations, realized by Smith, which indicated that this reaction was positive (probably this character may be ephemeral). Indeed, some cystidia show a very faint bluish tinge, more pronounced towards the apex, but by no means can we consider them as typically amyloid. On the other hand, only some of the specimens examined of *Chroogomphus ochraceus* (European and American) presented some very faintly amyloid basidia (as pointed already by SMITH & DREISINGER 1954). This reaction, stated by MILLER (1964), has also been observed by us revising material of *C. rutilus*; however, this character does not seem to be constant, and, so, the latter author indicates that the basidia can also be dextrinoid.

The only significant difference, pointed earlier by SMITH & DREISINGER (1954) and MILLER (1964), can be found in the amyloidity of some hyphae of the pileipellis. Both *Chroogomphus ochraceus* and *C. rutilus* have a pileipellis consisting of hyaline hyphae (Figs. 4a-d), though we can observe clearly that some of them are typically amyloid in the former (Figs. 4a-b and 4d), a character which does not appear in the latter (Fig. 4c).

*Chroogomphus ochraceus* is a species which occurs under conifers. In USA it fruits preferably under *Pinus strobus* and *P. monticola* (pines with five needles), whereas in Europe it apparently forms ectomycorrhizal associations with pines with two needles (*P. pinaster*, *P. nigra* ssp. *salzmannii*, etc.). This ecological difference, together with the geographical isolation, maybe should be taken into consideration in order to recognize two different mycoecotypes with the rank of subspecies (*C. ochraceus* ssp. *ochraceus* and *C. ochraceus* ssp. *fulmineus*); however, no morphological differences between the American and European material can be established. Moreover, SINGER (1949) indicates that *C. ochraceus* also fruits under *Abies* sp., *Pseudotsuga* and *Tsuga*, a fact that supports the assumption that the ecological range of this taxon, within the conifers, probably may be much wider and not restricted to *Pinus* species.

### Acknowledgements

We wish to thank the curator of the Michigan herbarium (MICH) for sending us the holotype as well as material of *Chroogomphus ochraceus*. We are also grateful to Dr. Courtecuisse for lending us material of *C. fulmineus* and some unpublished annotations of the latter. Finally, we thank Drs. J.M. Barrasa and V. González for their help with the realization of the microphotographs.

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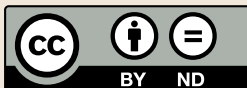
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