

# *Gastrolactarius denudatus* (Basidiomycotina, Russulales), a new species from Mexico

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## *Gastrolactarius denudatus* (Basidiomycotina, Russulales), una nueva especie en México

**Resumen.** Se propone *Gastrolactarius denudatus* como especie nueva para la ciencia, el cual se diferencia por la carencia de peridio, poseer un latex blanquecino opalescente, basidioma diminuto y cistidios lageniformes. Se recolectó creciendo de forma epigea bajo *Pinus patula*. Se comentan sus afinidades con especies próximas.

**Palabras clave:** Basidiomycotina, Russulales, *Gastrolactarius*, taxonomía, ecología, México.

**Abstract.** *Gastrolactarius denudatus* is proposed as a new species, showing as the main differential characters the absence of a peridium, presence of watery white latex, small basidioma and lageniform cystidia. It was found growing epigeal under *Pinus patula*. Comments on its affinities with close species are also included.

**Key words:** Basidiomycotina, Russulales, *Gastrolactarius*, taxonomy, ecology, Mexico.

## Introduction

The genus *Gastrolactarius* was proposed by Heim [6] and *Elasmomyces densus* R. Heim was chosen as the type species. However, it was forgotten until now, when Vidal [14] has revived it. According to this author's definition *Gastrolactarius* has: "Basidioma hemiangiocarpic, lactarioid, secotioid, with a well-developed stipe. Pileus 1-8 cm diam., initially angiocarpic, globose, on expanding convex, applanate or depressed, rarely becoming fully expanded; margin initially attached to stipe, often exposing the underlying gleba at maturity. Peridium smooth, sometimes viscid. Gleba sublamelliform, radiate to loculate-labyrinthoid; cavities empty to partially filled with spores. Stipe-columella percurrent. Context white. Latex always present. Spores globose to broadly ovoid, 8-15  $\mu$ m long, hyaline or yellowish, heterotropic to suborthotropic,

statismosporic, ballistosporic rarely active; with an eusporial ornamentation of partial to complete reticulum or echinate, covered with an amyloid myxosporium, usually with a suprahilar plage; hilar appendix conic. Basidia clavate, 2-4-spored. Cystidia and macrocystidia present or not, pseudocystidia often present. Subhymenial layer pseudoparenchymatous. Hymenial trama homomerous, sometimes with few sphaerocysts; clamp-connections absent; laticiferous hyphae abundant in all tissues. Context heteromerous. Peridiopellis a cutis, an ixocutis or a trichoderm.

Habitat & distribution: Epigeous or subhypogeous, ectomycorrhizal with trees, known from North America, Africa and Australasia. Phylogenetical relationships: *Lactarius* Pers. Type species: *Gastrolactarius densus* (R. Heim) J.M. Vidal (= *Elasmomyces densus* R. Heim)."

Thus, the genus *Gastrolactarius*, which is in accordance with the *Arcangeliella* concept sensu Singer & Smith [12], Pegler & Young [10] and Thiers [13], could well be suitable to accommodate the *Lactarius*-related sequestrate

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secotioid fungi. Vidal [14] accepts 12 species, but future studies using molecular biology methods will possibly approach to the real number of taxa to be included in *Gastrolactarius*.

As a result of the stay in Mexico of one of us (FDC), we had the opportunity to study two collections of this fungus, whose main characters are shown below.

## Material and methods

MEXICO: Veracruz, Xico, Cofre de Perote, El Revolcadero, Tembladeras, under *Pinus patula*, epigeous, 2850 m, 3-X-1985, L. Montoya 386 XAL. (**Holotypus**). MA-Fungi 59518 (**Isotypus**). Las Vigas, Cofre de Perote, km. 11 in the road Las Vigas-El Llanito, in mixed forest, under *Pinus* and *Alnus*, 2720 m, 3-X-1985, L. Villarreal XAL.

The methodology followed in this work is the ordinary one in mycology, using both micro and ultramicroscopic techniques.

### Description of the material studied

***Gastrolactarius denudatus*** Calonge & J.M. Vidal, sp. nov. Etymology: *denudatus*, means nude, devoid of a peridium.

Pileus 3-15 x 3-13 mm latus, siccus, subglobosus vel ovoideus, cum apertura crateriformis apicalis. Peridium absum. Stipite cylindracea, 2-3 x 1-1.5 mm. Columella percurrente solida. Gleba labyrinthiformis, alveolata, cremea. Sporae 8-11 x 6-8 µm, ovoideae ad ellipsoideae, heterotropae, subreticulatae, amyloideae. Basidia 30-40 x 8-12 µm, tetrasporica. Macrocystidia 35-90 x 8-10 µm, rara. Latex albidus, immutabilis. Sapor et odor mitis. Holotypus: Mexico, Veracruz, Xico, Cofre de Perote, El Revolcadero, circa Tembladeras, subter *Pinus patula*, epigea, 2850 m, 3-X-1985, legit L. Montoya 386 (XAL). *Isotypus* (MA-Fungi, 59518).

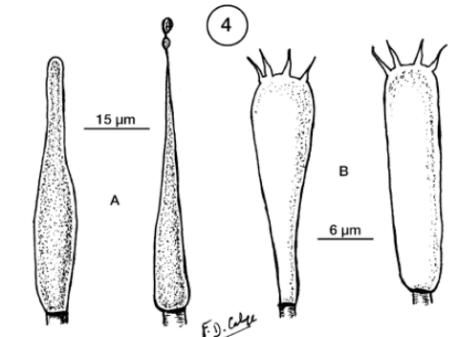
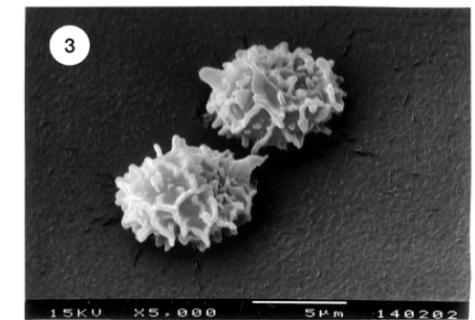
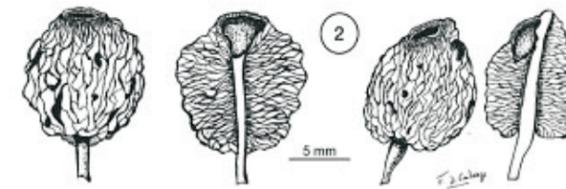
Basidioma consisting of a pileus, subglobose to

ovoid, 3-15 x 3-13 mm diameter, dried, and a stipe-columella percurrent. Peridium lacking. Gleba totally exposed, showing a pale cream tint (Fig. 1) and a very typical morchelliform to cerebriform aspect. It resembles very much to a tiny *Morchella esculenta* (Figs.1-2), with a labyrinthic structure, made of alveoles and sublamellar elements (Fig. 2). The apical portion shows a crater up to 2 mm diameter with a well-developed edge (Fig. 2). At a first look, it seems like a hole made by larvae, but it is natural since appears in every basidioma and always showing a crenulate edge (Figs. 1-2). Stipe cylindrical, 2-3 x 1-1.5 mm, and prolonged by a percurrent white columella (Figs. 1-2). Spores 8-11 x 6-8 µm, ornamentation included, which consists of a broken amyloid reticulum 0.4-0.8 µm thick, ovoid to ellipsoid, heterotropical (Fig. 3), with a well-developed hilar appendage, 1-2 µm long, suprahilar plage absent. Macrocystidia rare, lageniform, 35-90 x 8-10 µm, with granular contents, sometimes with a prolonged pointed ending (Fig. 4A). Basidia 30-40 x 8-12 µm, claviform to cylindrical, 4-spored, with sterigmata up to 5 µm long (Fig. 4B). Laticiferous hyphae very abundant, 2-5 µm diameter. Latex watery white, immutable, which soon disappears. Odor and taste mild.

Holotypus: Mexico, Veracruz, Xico, Cofre de Perote, El Revolcadero, near Tembladeras, under *Pinus patula*, epigeous, 2850 m, 3-X-1985, L. Montoya 386 XAL. *Isotypus*: MA-Fungi 59518.

## Discussion

The genus *Gastrolactarius* R. Heim ex J.M. Vidal accommodates those secotioid fungi related to *Lactarius*, after a segregation from the genus *Arcangeliella* Cav., according to Heim [6]. On the other hand, all the sessile, gasteroid species, lacking a stipe-columella were retained in *Arcangeliella*, following Cavara's original concept [2]. The relationships between *Arcangeliella* and *Lactarius* are so closely that they



Figures 1-4 *Gastrolactarius denudatus*. 1. Basidiomata as seen complete and in cross section, from the herbarium material. Holotypus. 2. Diagrammatic representation of the same material. 3. Spores asymmetrical showing a broken reticulum and a well-developed hilar appendage. Holotypus. 4. Cystidia of two types (A) with granular contents and basidia claviform and cylindrical (B). Holotypus.

consider the *Arcangeliella* species as "aborted states" of *Lactarius*. Fact recently confirmed by molecular biology studies [9]. Singer & Smith [12] included the secotioid species in this genus, too; criterion which was followed by posterior authors [10, 13], producing the subsequent confusion.

These authors conferred the presence of sphaerocysts to the hymenial trama of *Arcangeliella*, so as Lebel & Trappe [8]. This fact was due to study a wrong type material considered as *A. borziana* Cav., which was really *Macowanites mattirolanus* Cav., as it was later demonstrated by Vidal [15]. Both genera *Arcangeliella* and *Gastrolactarius* have homomerous hymenial trama; only in very rare occasions it can be possible to observe some sphaerocysts.

The Mexican material studied by us in this paper fits well within the genus *Gastrolactarius*: showing laticiferous secotioid basidioma, homomerous hymenial trama, hymenial

macrocystidia and heterotropic, amyloid spores. A differential character from the other species of the genus is the lack of a peridium. Other close Mexican species belonging to the genus *Cystangium* Singer & A.H. Smith, *C. pineti* Singer, has been collected in the same area [11] but it can be separated from *Gastrolactarius denudatus* in the following characters: presence of a bright reddish-roseus peridium, columella not quite percurrent, spores with ornamentation forming crests, more rarely reticulate and basidia predominantly 2-spored.

There are few sequestrate species which having an angiocarpic origin have evolved towards a complete gymnocarpic. Only within the Boletales it is possible to find some cases of secotioid fungi with gymnocarpic representatives, e. g. in *Gymnopaxillus* Horak, *Singeromyces* Moser and *Gymnogaster* J.W. Cribb, all from Argentina and Australia [1, 3, 4, 7, ].

Since all the herbarium material studied was mature,

we were unable to observe any rest of the original peridium. With evanescent peridium there are several taxa of the genera *Arcangeliella*, *Cystangium* and *Gymnomyces* Massee & Rodway. In such cases it is possible to find species which initially show a membranous peridium which disintegrates later: *A. australiensis* (Berk. & Broome) C.W. Dodge, *A. gardneri* (Zeller & C.W.Dodge) Zeller & C.W. Dodge, *Cystangium seminudum* (Massee & Rodway) T. Lebel & Castellano and *Gymnomyces ilicis* J.M. Vidal & Llistosella. There is a representative within Russulales, *Lactarius rubriviridis* Desjardin, Saylor & Thiers, found recently in California [5], which looks alike to our Mexican specimens, but it lacks any stipe; it is sessile with a dendroid columella.

Regarding the presence of a crater-like cavity in all the Mexican specimens studied, it could be due to the action of a fungivorous insect larva during the first stage of its life-history, after coming out of the egg, being feeded with the columella flesh until its complete development, moment when it opens a hole to get out. However, no rest of the insect has been observed on the basidiomata studied.

In conclusion, the small, epigeal, morchelliform basidioma, provided with an apical crater, the presence of immutable watery latex, lageniform cystidia, well-developed percurrent stipe-columella and absence of a peridium, compile a combination of characters enough to propose our material as a new species.

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