

## NEW ADDITIONS OF MACROMYCETES FOR MEXICO

## NUEVAS ADICIONES DE MACROMICETOS PARA MÉXICO

Olivia Rodríguez Alcántar<sup>1\*</sup>, María De Jesús Herrera-Fonseca<sup>1</sup> & Darío Figueroa-García<sup>1</sup>

<sup>1</sup>Laboratorio de Micología, Departamento de Botánica y Zoología, Centro Universitario de Ciencias Biológicas y Agropecuarias (CUCBA), Universidad de Guadalajara, Apartado postal 1-139, Zapopan 45101, Jalisco México.

\*Autor para Correspondencia: [olivia.rodriguez@academicos.udg.mx](mailto:olivia.rodriguez@academicos.udg.mx)

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### ABSTRACT

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### PALABRAS CLAVE:

Basidiomycota,  
micobiota,  
taxonomía.

### KEYWORDS:

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Different mycobiotic studies have been conducted in recent years in many states or regions in Mexico, which have increased the knowledge of fungal diversity and species richness in the country. The objective of this study is to contribute to the knowledge regarding the Mexican mycobiota. The studied material was collected in oak, pine-oak, cloud and tropical deciduous forests in the municipalities of Poncitlán, San Sebastián del Oeste and Zapopan of the state of Jalisco, in Mexico. The material of the mycological collection of the herbarium IBUG was also reviewed. The specimens were studied using traditional mycological techniques and specialized literature for identification. Five new records for the Mexican mycobiota are reported for the first time: *Aseroe coccinea* Imazeki & Yoshimi ex Kasuya, *Cymatoderma sclerotioides* (Lloyd) D.A. Reid, *Gymnopus foetidus* (Sowerby) P.M. Kirk, *Macrocyttidia cucumis* f. *minor* Joss. and *Russula pseudoaeruginea* (Romagn.) Kuyper & Vuure, all of which belong to the division Basidiomycota. A description of these taxa is presented along with photographs of the basidiomes and microscopic structures. It is considered necessary to continue conducting mycological explorations, since there are still localities that have been little explored or even unexplored. Undoubtedly, further explorations would lead to the discovery of a greater number of fungal species, distributed in the different vegetation types of Mexico.

### RESUMEN

Diferentes estudios micobióticos se han realizado en los últimos años en buen número de estados o regiones de México, lo que ha incrementado el conocimiento sobre su diversidad fúngica y riqueza de especies, por lo que el objetivo de este trabajo es contribuir a su conocimiento. El material estudiado fue recolectado en bosque de encino, pino-encino, mesófilo de montaña y tropical caducifolio proveniente de los municipios de Poncitlán, San Sebastián del Oeste y Zapopan del estado de Jalisco. Se revisó también el material de la colección micológica del Herbario IBUG. El estudio de los ejemplares se llevó a cabo utilizando las técnicas tradicionales micológicas, y el uso de literatura especializada para su determinación. Se reportan por primera vez cinco registros nuevos para la micobiota mexicana: *Aseroe coccinea* Imazeki & Yoshimi ex Kasuya, *Cymatoderma sclerotioides* (Lloyd) D.A. Reid, *Gymnopus foetidus* (Sowerby) P.M. Kirk, *Macrocyttidia cucumis* f. *minor* Joss. y *Russula pseudoaeruginea* (Romagn.) Kuyper & Vuure, todos ellos pertenecen a la división Basidiomycota. Se presenta la descripción de los taxa, fotografías de los basidiomas y estructuras microscópicas. Se considera necesario seguir realizando exploraciones micológicas, dado que siguen existiendo localidades poco o nada exploradas, lo que sin duda permitirá conocer un mayor número de especies fúngicas, distribuidas en los tipos de vegetación presentes del país.

## INTRODUCTION

According to the latest studies from Hawksworth & Lücking (2017), it is estimated that there could be between 2.2 and 3.8 million species of fungi worldwide. At present, in Mexico, it is estimated that there could be around 200,000 species of fungi, of which more than 4,500 macromycete and 2,000 micromycete taxa have been recorded. This species of fungi represent between 3.2 and 6% of the species known for the country, and in which the state of Jalisco is cited as having the second highest number of records, with 1,040 species, exceeded only by the state of Veracruz, with 1,517 (Aguirre-Acosta et al., 2014).

Mexico is considered one of the countries with the greatest fungal diversity, and the knowledge of this diversity has been increased in the last 30 years through monographic studies and inventories conducted in different regions, mainly in the center and south of the country (Torres Preciado et al., 2020). As a further contribution to the knowledge of the diversity of fungal species in the Mexican territory, this study contributes with new records of macromycetes of the division Basidiomycota from the state of Jalisco in the

municipalities of Poncitlán, San Sebastián del Oeste and Zapopan (Figure 1). The taxa recorded are cited as rare according to the bibliography consulted, and their economic importance and distribution is described (Breitenbach & Kränzlin, 1991; Noordeloos, 1995).

## MATERIAL AND METHODS

Specimens deposited in the herbarium IBUG were reviewed. Study and description of the microscopic characteristics were conducted following the mycological techniques proposed by Largent et al., (1977) and Vellinga (1998), respectively. Handmade thin sections of different parts of the sporome were mounted in KOH (3%), solution Melzer, Congo red and Cotton blue, and observations were made with optical microscope Zeiss (K-7, Jena, Germany). A specialized bibliography was consulted for determination of the taxa examined, including Breitenbach & Kränzlin (1991), Calonge (1998), Kasuya (2007) and Ryvarden (2010), among others. For the names of authors, synonyms and validation of the taxa determined, the Index Fungorum (2021) and Mycobank (2021) were consulted. The description of the new records and photographs of some of the taxa cited in the study are presented.



**Figure 1.** Location of the sites of material collected from different municipalities of the state Jalisco, Mexico.



**Figure 2.** A) *Aseroe coccinea*; B) basidiospores *A. coccinea*; C) *Macrocytidia cucumis* f. *minor*; D) *Cymatoderma sclerotioides* with sclerotium; E) skeletal hyphae of *C. sclerotioides*; F) pileipellis of hyphae with pigment in bands of *Macrocytidia cucumis* f. *minor*. Photos: D. Figueroa-García and O. Rodríguez Alcántar.

## RESULTS

*Aseroe coccinea* Imazeki & Yoshimi ex Kasuya, Mycoscience 48(5): 309 (2007). (Figure 2 A–B)

Description: Basidiome opens in the form of an octopus or star with 5–7 arms, with obtuse tips without bifurcation, of brilliant red color, in the center of the arms is suspended the gleba, which is green. Stipe  $70 \times 10$  mm, with wrinkled surface, whitish, this develops from a persistent volva which is papery in consistency and fragile when dry, whitish with cream tones, and the presence of rhizomorphs, whitish. Spores  $3.6\text{--}4.4 \times 1.2\text{--}2$   $\mu\text{m}$ , elongated to cylindrical, subthick walls and truncated apex, hyaline.

Comments: The specimen were determined according to that reported by Kasuya (2007), who describes spores of  $4\text{--}5 \times 2\text{--}2.5$   $\mu\text{m}$ , ellipsoid to cylindrical, of thick walls and truncated base. Macroscopically, this species is very similar to *A. rubra* Labill. due to the star shape and coloration of the arms, but the latter species presents eight or more arms with bifurcated tips. *Aseroe coccinea* has been reported in Europa and Asia (Kasuya op. cit.), and is now reported as a new record in the Mexican mycobiota.

Habit and Habitat: Solitary, on soil, in pine-oak forest. Material studied: MEXICO, Jalisco, municipality of Zapopan, Bosque La Primavera, 13 September 2015, J. P. Dávila-Núñez 21 (IBUG).

*Cymatoderma sclerotioides* (Lloyd) D.A. Reid, Kew Bull. [13](3): 528 (1959) [1958]. (Figure 2 D–E). =*Stereum sclerotioides* Lloyd, Mycol. Writ. 7 (Letter 66): 1115 (1922).

Description: Basidiome pileate-stipitate, infundibuliform, of 45 mm broad, with surface strongly tomentose-pubescent in some parts, with folds in a radial arrangement, cream in color with greyish to brown-greyish tones towards the center, edge uplifted, and without folds towards the stipe, tomentose of greyish-cream with darker greyish-brown tones towards the edge. Stipe  $90 \times 6$  mm, central, with a surface strongly tomentose-velutinous, greyish-brown with orange and greyish tones, the base presents a cotton-like mass corresponding to that of a sclerotium of  $55 \times 35$  mm in diameter, compact, greyish-whitish in color with brown tones. Spores not observed. Hyphal system dimitic, generative hyphae of  $3.6\text{--}4.6$   $\mu\text{m}$  broad, septate, with thin-subthick wall, hyaline, con fibulae, skeletal hyphae

of 3.9–4.8  $\mu\text{m}$  broad, and with a marked lumen of 6.8  $\mu\text{m}$  broad.

Comments: The species concurs with that observed by Ryvar den (2010), who emphasizes that it is the only example within the genus that presents a sclerotium. Under the microscope, it presents a dimitic hyphal system, as reported by this author, no spores were observed in the study material, a characteristic that was impossible to corroborate with the literature. However, the rest of the macro and micromorphological characteristics correspond to those described as *Cymatoderma sclerotioides*. This is the first record of this species in Mexico, since it has hitherto reported from Africa (Mata, 1999), Brazil and Panama (Welden, 1960) and in Central and South America (Franco-Molano et al., 2005).

Habit and Habitat: Solitary, on soil, in cloud forest.

Material studied: MEXICO, Jalisco, municipality of San Sebastián del Oeste, km 2–3 road to San Sebastián del Oeste a la Bufa, 6 October 2012, M. Camacho 738 (IBUG).

*Gymnopus foetidus* (Sowerby) P.M. Kirk, Index fungorum 120: 1 (2014). = *Micromphale foetidum* (Sowerby) Singer, 8(3): 182 (1945).

Description: Pileus 5–20 mm broad, umbilicate, glabrous, hygrophanous, brown-orange in color with a darker center of reddish-brown, striated by transparency. Lamellae free, adnate, broad, distant, translucent, with entire edge, whitish-pink. Stipe 6–16  $\times$  0.5–2 mm, central to excentric, pilose, thin, slightly widened and flattened towards the base, blackish in color. Context hole in the pileus, of cartilagenous consistency on maturation, with an odor of garlic. Spores 7.6–9.2  $\times$  3.5–5  $\mu\text{m}$ , elongated-cylindrical, lacrimoids with suprahilar depression, with droplets of refractive content, hyaline. Hymenophorous trama intertwined, hyphae septate with fibulae, hyaline. Cheilocystidia 25.6–35.5  $\times$  4.8–6  $\mu\text{m}$ , cylindrical to subfusiform, with obtuse apex, thin walled, hyaline. Caulocystidia 24–77.6  $\times$  4.8–12  $\mu\text{m}$ , cylindrical non-flexuose to lageniform, with apex obtuse to subcapitate, thin walled to subthick, light brown in color, present on the apex of the stipe. Pileipellis of cutis type, with septate hyphae, with clamp connections and pigment encrusted on the wall, forming bands of yellowish-brown color.

Comments: The material was determined as described by Breitenbach & Kränzlin, (1991) who cited it as *Micromphale foetidum*. The characteristics present in the studied specimen share the shape and size of the cystidia described by Breitenbach & Kränzlin (1991), apart from the caulocystidia observed in the Mexican specimen; these differ from those cited by these authors, who only report the presence of terminal hyphae on the apex of the stipe. Similarly, they compare the studied

species to *Gymnopus brassicolens* (Romagn.) Antonín & Noordel., which presents a similar morphology, but is distinguished by being humicolous, a characteristic of ecological importance that distinguishes it from *G. foetidus*, which grows on wood. Noordeloos (1995) describes the species cited here as having spores of 7.5–10  $\times$  3.5–5  $\mu\text{m}$ , with neither pleuro nor cheilocystidia, with caulocystidia present on the apex of the stipe 10–65  $\times$  7–10  $\mu\text{m}$ , cylindrical, light brown in color and with a pileipellis of cutis type, formed by hyphae with encrusted pigment. This author also compares the species with *G. brassicolens*, from which it can be distinguished through the presentation of smaller spores of 5–7  $\times$  3–4  $\mu\text{m}$ , with pileipellis formed by a gelatinized layer and by the habitat in which it grows. Noordeloos (1995) reports it from southeastern Belgium, growing gregariously in the humus of deciduous forests of *Fagus*, *Quercus* and *Castanea*. Breitenbach & Kränzlin (1991) cited it in Europe, collected mainly in forests with elements of *Fagus* and *Corylus*. Its distribution has thus been broadened by this new record in Mexico.

Habit and Habitat: Gregarious, on wood, in pine-oak forest.

Material studied: MEXICO, Jalisco, municipality of San Sebastián del Oeste, road to Real Alto-La Bufa, 3 km from the village of San Sebastián del Oeste, 28 July 2008, O. Rodríguez 3370 (IBUG).

*Macrocyttidia cucumis* f. *minor* Joss., Bull. Trimest. Soc. mycol. Fr. 49(3–4): 373 (1934) [1933]. (Figure 2 C and F).

Description: Pileus 12 mm broad, convex-papillate, with the surface glabrous and of velutinous appearance, margin with a translucent ridged edge, light brown in color with tones of reddish-brown and with detachable cuticle. Lamellae free, ventricose, with fimbriate edge, whitish-pink. Stipe 40  $\times$  1.5 mm, central, glabrous with velutinous appearance, concolorous with the pileus but with reddish-pink tones. Context thin on the pileus, of cream-brown color towards the lamina and with a hole in the stipe. Consistency cartilagenous, not fragile or brittle, with no flavor and with an unpleasant odor. Spores 6.8–8.4  $\times$  3.6–4.4  $\mu\text{m}$ , elongated-cylindrical, smooth, wall subthick, with reddish-pink tones. Pleurocystidia 54–63  $\times$  10–12.8  $\mu\text{m}$ , conical, with rostrate apex, with granular content, of yellowish-orange in color. Cheilocystidia 53.4–64  $\times$  9.9–12.8  $\mu\text{m}$ , conical with apex acute to rostrate, of yellowish-brown in color. Caulocystidia 51.3–62.5  $\times$  9.8–15  $\mu\text{m}$ , conical, thin walled with slightly mucronate apex of yellowish-brown in color.

Comments: The specimen was determined according to Breitenbach & Kränzlin (1991) who describe the species with spores 7.2–8(–9)  $\times$  3.6–4.4  $\mu\text{m}$  and the pleurocystidia, cheilocystidia, caulocystidia and elements of the pileipellis lanceolate. Noordeloos (1995) describes *Macrocyttidia cucumis* f. *minor* with

a pileus of 8–25 mm, dark brown in color towards the center with lighter tones towards the margin, which is translucent striate, a characteristic that distinguishes it from *Macrocystidia cucumis* f. *cucumis* (Pers.) Joss, by not presenting a translucent ridged edge and having a larger basidiome of 15–50 mm in diameter. Breitenbach & Kränzlin (1991) report the species in deciduous and coniferous forests of Europe, Asia, Africa and North America, but not as a common species. Noordeloos (1995) cites it from Europe, of solitary to gregarious habit in deciduous forests, also found in *Leymus arenarius* (L.) Hochst. Its distribution has thus been broadened by this new record in Mexico.

Habit and Habitat: Solitary, on soil, in pine-oak forests. Material studied: MEXICO, Jalisco, municipality of San Sebastián del Oeste, road to Real Alto-La Bufa, 3 km from the village of San Sebastián del Oeste, 27 July 2008, O. Rodríguez 3369 (IBUG).

*Russula pseudoaeruginea* (Romagn.) Kuyper & Vuure, *Persoonia* 12(4): 451 (1985). = *Russula aeruginea* var. *pseudoaeruginea* Romagn., *Bull. mens. Soc. linn. Soc. Bot. Lyon* 21:111 (1952).

Description: Pileus 80 mm broad, convex, centrally depressed, edger arcuate, smooth, yellowish-green. Lamellae subadhered, joined, subwide, whitish in color, turning to yellowish. Stipe cylindrical, slightly thinner towards the base, cavernose, whitish in color with grey tones. Spores 7–8.5 × 5.2–7.6 µm, subglobose to widely ellipsoid, ornamented with small warts of up to 0.5 µm, partially reticulate in form, with supra-appendicular plaque, inamyloid. Pileipellis with sparse macrocystidia of 12–25 × 6–9 µm, cylindrical and slightly claviform, frequently with the apex mucronate or mamillated, mainly articulated with inflated cells.

Comments: The collected specimen shows macro and micromorphological characteristics typical of the species *Russula pseudoaeruginea*, which is characterized by an olive green to yellowish-green pileus, this with a central depression, spores of 6.5–8.5 × 5.2–7 µm, and macrocystidia on the cuticle of the pileus. The specimen examined matches that described by Romagnesi (1967), but differs in that it presents spores with a smaller ornamentation from that described in European material in which warts can be of up to 1 µm in height. One similar species is *Russula aeruginea* Lindblad, but it presents larger basidiomes of up to 150 mm in diameter and larger [(6.5–) 7–9 (–10) × 5–6 (–7) µm] and non-reticulated spores, as well as growing associated with pines, unlike *R. pseudoaeruginea*, which develops with broadleaf species such as *Tilia parvifolia* Ehrh. and *Quercus* spp.

Habit and Habitat: Gregarious, on soil, scarce, in oak forests.

Material studied: MEXICO, Jalisco, municipality of Poncitlán, Cerro Colorado, road to the pinturas

rupestres, 7 August 2008, G. Blanco 63 (IBUG).

## DISCUSSION

In the present study, five new records of Basidiomycota are presented for the first time for Mexico, specimens were collected from different locations sampled in the state of Jalisco.

The above comments indicate that studies on fungal diversity are still scarce and further efforts are required to knowledge of Mexican mycobiota in unexplored environments, mainly on tropical vegetation and cloud forest.

Some of the taxa described in this work are rare and of restricted distribution as *Cymatoderma sclerotioides* from Brazil and Panama (Reid, 1958 and Welden, 1960).

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