

Rinodina fuscoisidiata, a new muscicolous, isidiate species from Venezuela

Mireia GIRALT, Klaus KALB and John A. ELIX

Abstract: *Rinodina fuscoisidiata*, a muscicolous isidiate species with large isidia and *Pachysporaria*-type ascospores is described from Venezuela. This species contains an unknown terpene as a major secondary metabolite in addition to traces of atranorin. It is compared with the four known isidiate *Rinodina* taxa.

Key words: South America, taxonomy, lichenized fungi, *Physciaceae*, Lecanoromycetes

Introduction

While revising the species of the genus *Rinodina* (Ach.) Gray belonging to the *Dolichospora* group (at present including *R. brasiliensis* Giralt, Kalb & H. Mayrhofer, *R. dolichospora* Malme, *R. guianensis* Aptroot, *R. intermedia* Bagl. and *R. inspersoparietata* Giralt & van den Boom), typically characterized by containing drops of uncertain origin and nature surrounding the lumina of the ascospores (Giralt *et al.* 2008, 2009), we examined several muscicolous, isidiate *Rinodina* specimens from Venezuela collected at high altitude in open Paramo vegetation. These specimens were somewhat similar in habit to the isidiate but corticolous *R. brasiliensis* occurring in tropical rainforests, but, because of their different ecological behaviour we suspected that they belonged to a new *Rinodina* species. Detailed morphological and chemical studies have shown that they can be clearly distinguished from *R. brasiliensis* by the absence of inclusions in the ascospores and by an alternative chemistry.

M. Giralt: Departament de Bioquímica i Biotecnologia (Àrea de Botànica), Facultat d'Enologia de Tarragona, Universitat Rovira i Virgili, Marcel·lí Domingo s/n, 43007, Tarragona, Spain. Email: mireia.giralt@urv.cat
K. Kalb: Lichenologisches Institut Neumarkt, Im Tal 12, D-92318 Neumarkt, Germany.

J. A. Elix: Research School of Chemistry, Building 33, Australian National University, Canberra, ACT 0200, Australia.

Materials and Methods

The specimens were examined by standard techniques using stereoscopic and compound microscopes. Current mycological terminology generally follows Kirk *et al.* (2001). Only free ascospores lying outside the asci have been measured. Measurements were made in water at $\times 1000$ magnification. Mean value (\bar{x}) and standard deviation (SD) were calculated and the results are given as (minimum value observed) $\bar{x} \pm$ SD (maximum value observed) followed by \bar{x} , SD and n (the total number of ascospores measured) in parentheses. The terminology used for the asci follows Rambold *et al.* (1994) and for the ascospore-types and ascospore-ontogenies Giralt (2001). Chemical constituents were identified by thin-layer chromatography (TLC) and high performance liquid chromatography (HPLC) (Elix *et al.* 2003).

The Species

Rinodina fuscoisidiata Giralt, Kalb & Elix sp. nov.

Rinodinae guianensis similis, sed thallo et terpenum ignotum et atranorinum continenti, isidiis majoribus, *c.* 0.07–0.2 \times 0.07–1 mm, apotheciis lecanorinis et majoribus, *c.* (0.5–)0.7–0.9(–1.2) mm latis, et ascosporis majoribus, *c.* (17–)20–25(–29) \times (9–)10.3–12.7(–14) μ m differt.

Typus: Venezuela, Mérida, distr. Rangel, zwischen Laguna Mucubaji und Pico Mucuñuque, etwa 15 km SE von Apartaderos. In Paramo-Vegetation, 3500 m, 8°45'N; 70°45'W, 7, 8 & 16 August 1989, K. & A. Kalb & López-Figueiras (hb. Kalb 27013—holotypus; GZU, hb. Kalb 27013—isotypus).

(Figs 1 & 2)



FIG. 1: *Rinodina fuscoisidiata*, habitus showing the isidiate thallus and the apothecia with plane discs and prominent thalline margins (holotype). Scale = 1mm.

Thallus muscicolous, crustose, densely isidiate, spreading. *Isidia* simple and globose at first, 0.07–0.2 mm diam., becoming cylindrical, simple or more commonly branched or coralloid, up to 1 mm long, pale chestnut brown to dark brown, darker and often erumpent at the apices, not forming soredia or blastidia (Fig. 1). *Cortex* paraplectenchymatous, 20–35 μm thick, composed of mesodermatous hyphae with rounded to \pm elongate cells 7–10 μm (textura globularis to angularis), chestnut brown pigmented in the outermost part, colourless in the inner part, totally interspersed with crystals soluble in K. *Medulla* 60–130 μm , I+ pale blue, totally interspersed with crystals soluble in K. Algal cells chlorococcoid, 8–15 μm diam.

Apothecia lecanorine, sessile to shortly stipitate, markedly constricted at the base, with a short brown stipe, usually scattered, (0.5–)0.7–0.9(–1.2) mm diam. Thalline margin concolorous with isidia, thick, prominent, entire to verrucose, becoming isidate,

sometimes partially excluded. *Disc* dark brown, concave to flat, funnel-shaped with age, epruinose. *Proper margin* entire, thin, clearly visible when the thalline margin is partially excluded. *Thalline exciple* 80–120 (–140) μm wide, totally interspersed with crystals soluble in K; cortex paraplectenchymatous, 10–20 μm wide in the lateral part, expanded to 40–50(–80) μm below, I+ pale blue. *Proper exciple* indistinct laterally to 25 μm thick, expanded to 35–50(–70) μm above. *Hymenium* colourless, 100–120 μm high; epihymenium chestnut brown. *Hypothecium* colourless, 90–125 μm deep. *Paraphyses* 1–1.5 μm wide, apical cells 3–5 μm wide, with brown cap. *Asci* *Lecanora*-type, 8-spored. *Ascospores* *Pachysporaria*-type, (17–) 20–25(–29) \times (9–)10.3–12.7(–14) μm ($M=22.5 \times 11.5 \mu\text{m}$; $SD=2.5/1.2 \mu\text{m}$; $n=75$), with irregularly rounded lumina, sometimes with protrusions towards the spore ends, when mature slightly constricted at septum, walls not ornamented, torus absent or poorly

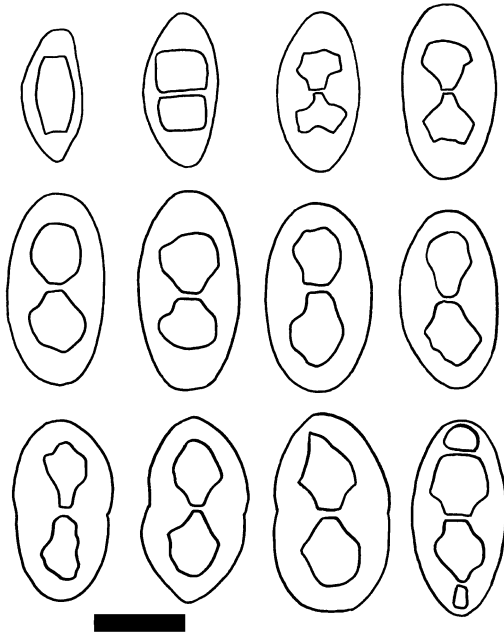


FIG. 2. *Rinodina fuscoisidiata*, ascospore ontogeny type B and ascospore variability (holotype). Scale = 10 μ m.

developed, ontogeny of type B; many simple, colourless ascospores with apical wall thickenings are always present; when overmature a few ascospores show an additional apical lumina in each cell (Fig. 2).

Pycnidia and *conidia* not seen.

Chemistry. Thallus, isidia and thalline margin K+ yellow, C–, KC–, Pd–, UV–. Containing atranorin [minor] and an unknown terpene [major] by TLC, HPLC. Because of the brown colour of the thalline cortex the K+ yellow reaction can be seen more easily under the microscope. After the application of K, the crystals present in the cortex and the medulla dissolve giving a yellowish coloration; after a few seconds, colourless, acicular crystals 4.5–10 μ m long develop from the lichen tissue and these later regroup to form star-like structures. When K was applied to the moss substratum no crystals developed.

Ecology and distribution. The new species is known only from Merida province in

Venezuela. It is growing over mosses on humid granitic boulders in open paramo vegetation between 3500 and 4200 m. Accompanying species are *Tetramelas regionontanus* Marbach, *Rinodina stictica* Sheard & Tønsberg and *Buellia* aff. *proximata*.

Observations. *Rinodina fuscoisidiata* is characterized by its continuous, brown, densely isidiate thallus, the presence of an unknown terpene (major) and atranorin (minor), the thick, long, simple or ramified to coralloid isidia and by the large *Pachysporaria*-type ascospores. The ascospores are smooth, slightly constricted at the septum, with a poorly developed torus or torus absent and develop with type B ontogeny.

There are only four other truly isidiate species of *Rinodina*: the corticolous/muscicolous *R. brasiliensis* Giralt, Kalb & H. Mayrhofer, *R. guianensis* Aptroot, *R. isidioides* (Borrer) H. Olivier and the saxicolous *R. placynthielloides* Aptroot. The tropical to subtropical *R. brasiliensis* and *R. guianensis* also have brownish isidia and *Pachysporaria*-type ascospores but lack secondary lichen substances. Furthermore their ascospores contain minute globular inclusions surrounding the lumina (compare Giralt *et al.* 2009). The oceanic-temperate *R. isidioides* has whitish to pale grey isidia united at the base into a subsquamulose structure and contains only atranorin (Sheard 1967; Giralt *et al.* 1995; Sheard 2004). Finally, *R. placynthielloides*, known only from the type locality in Taiwan, has small lecideine apothecia, up to 0.5 mm diam., smaller *Pachysporaria*-type ascospores up to 20 \times 10 μ m, 4-spored asci and lacks secondary metabolites (Aptroot & Sparrius 2003; see also Giralt & van den Boom 2008).

There are other vegetatively reproducing *Rinodina* species but they are all blastidiate or sorediate instead of isidiate and therefore cannot be mistaken for *R. fuscoisidiata*. The main studies including *Rinodina* taxa developing vegetative propagules are the following: Malme (1902), Sheard (1995) and Giralt *et al.* (1995), for the corticolous species; and Matzer & Mayrhofer (1994, 1996) and Giralt & van den Boom (2008),

for the saxicolous species. Additional blastidiate or sorediate *Rinodina* species not included in the compilations mentioned above are: *R. pityrea* Ropin & H. Mayrhofer (Ropin & Mayrhofer 1995); *R. australiensis* Müll. Arg. (Mayrhofer *et al.* 1999); *R. perreagens* Sheard and *R. juniperina* Sheard (Sheard & Mayrhofer 2002; Sheard 2004); *R. turfaceoides* van den Boom *et al.* (Giralt *et al.* 2001); and *R. evae* Fos & Giralt (Fos & Giralt 2009).

Additional specimens examined. **Venezuela:** Mérida: distr. Rangel, zwischen Laguna Mucubaji und Pico Mucuñuque, etwa 15 km SE von Apartaderos, in Paramo-Vegetation, 3500 m, 8°45'N; 70°45'W, 1989, K. & A. Kalb & López-Figueiras (hb. Kalb 27015—topotype); Sierra de Santo Domingo, umgebung des Karsees Laguna Negra, 3500 m, 1969, B. & F. Oberwinkler & H. Hertel 10474 (M); 3 km NE of Pico El Águila, 3900–4000 m, Paramo, on an open rocky slope, 1979, R. Santesson 29442 (UPS); distr. Miranda, Paramo zwischen Almorzadero und Piñango, 4200 m, 8°55'N; 70°50'W, 1989, K. & A. Kalb (hb. Kalb-27016).

The authors are indebted to the curators of the herbaria BCN, M and UPS, and to Helmut Mayrhofer for providing valuable information on additional specimens. The first author also thanks the 'Comissionat per a la Recerca' (Catalan Government) and the project CGL2007-66734-C03-02/BOS (Spanish Government) for financial support.

REFERENCES

- Aptroot, A. & Sparrius, L. B. (2003) New microlichens from Taiwan. *Fungal Diversity* **14**: 1–50.
- Elix, J. A., Giralt, M. & Wardlaw, J. H. (2003) New chloro-depsides from the lichen *Dimelaena radiata*. *Bibliotheca Lichenologica* **86**: 1–7.
- Fos, S. & Giralt, M. (2009) *Rinodina evae* (Physciaceae, lichenized Ascomycota), a new corticolous blastidiate species from Eastern Spain. *Nova Hedwigia* **88**: 33–40.
- Giralt, M. (2001) The lichen genera *Rinodina* and *Rinodinella* (lichenized Ascomycetes, Physciaceae) in the Iberian Peninsula. *Bibliotheca Lichenologica* **79**: 1–160.
- Giralt, M. & van den Boom, P.P.G. (2008) New *Rinodina* species from the Cape Verde Islands, with notes on some additional species. *Lichenologist* **40**: 523–533.
- Giralt, M., Kalb, K. & Mayrhofer, H. (2009) *Rinodina brasiliensis*, a new corticolous, isidiate species and its closest relatives. *Lichenologist* **41**: 1–9.
- Giralt, M., Mayrhofer, H. & Sheard, J. W. (1995) The corticolous and lignicolous blastidiate, sorediate and isidiate species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) in southern Europe and adjacent areas. *Lichenologist* **27**: 3–24.
- Giralt, M., Mayrhofer, H., van den Boom, P. P. G. & Elix, J. A. (2001) *Rinodina turfaceoides*, a new corticolous, blastidiate species from the Iberian Peninsula. *Lichenologist* **33**: 97–102.
- Kirk, P. M., Cannon, P. F., David, J. C. & Stalpers, J. A. (2001) *Ainsworth & Bisby's Dictionary of the Fungi*. 9th Edn. Wallingford: CAB International.
- Malmé, G. O. (1902) Die Flechten der ersten Regnellschen Expedition II. Die Gattung *Rinodina* (Ach.) Stiz. *Bihang til Kongliga Svenska Vetenskaps-Akademiens Handlingar* **28**(III/1): 1–53.
- Matzer, M. & Mayrhofer, H. (1994) The saxicolous *Rinodina teichophila* and three closely related species from the Southern Hemisphere (Physciaceae, lichenized Ascomycetes). *Acta Botanica Fennica* **150**: 109–120.
- Matzer, M. & Mayrhofer, H. (1996) Saxicolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) in southern Africa. *Bothalia* **26**: 11–30.
- Mayrhofer, H., Kantvilas, G. & Ropin, K. (1999) The corticolous species of the lichen genus *Rinodina* (Physciaceae) in Temperate Australia. *Muelleria* **12**(2): 164–194.
- Rambold, G., Mayrhofer, H. & Matzer, M. (1994) On the ascus types in the Physciaceae (Lecanorales). *Plant Systematics and Evolution* **192**: 31–40.
- Ropin, K. & Mayrhofer, H. (1995) Über corticole Arten der Gattung *Rinodina* (Physciaceae) mit grauem Epithemium. *Bibliotheca Lichenologica* **58**: 361–382.
- Sheard, J. W. (1967) A revision of the lichen genus *Rinodina* (Ach.) Gray in the British Islands. *Lichenologist* **3**: 328–367.
- Sheard, J. W. (1995) Disjunct distributions of some North American corticolous, vegetatively reproducing *Rinodina* species (Physciaceae, lichenized Ascomycetes). *Herzogia* **11**: 115–132.
- Sheard, J.W. (2004) *Rinodina*. In *Lichen Flora of the Greater Sonoran Desert Region Vol. II* (T. Nash III, B.D. Ryan, P. Diederich, C. Gries & F. Bungartz, eds): 457–492. Tempe: University of Arizona.
- Sheard, J.W. & Mayrhofer, H. (2002) New species of *Rinodina* (Physciaceae, lichenized Ascomycetes) from western North America. *Bryologist* **105**: 645–672.