

# *Lepraria juanfernandezii*, a new lichen species from the Southern Hemisphere

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**Abstract.** *Lepraria juanfernandezii* is described as a new species. It differs from all other species of *Lepraria* by its aggregate thallus with sparse prothallus hyphae, the absence of a hypothallus, the presence of divaricatic acid and the absence of zeorin, and its occurrence in the Southern Hemisphere. A key to all species of *Lepraria* containing divaricatic acid is given.

**Key words:** *Ascomycota*, *Cladoniaceae*, *Lecanorales*, secondary chemistry, sterile lichens

## Introduction

*Lepraria* is a genus of lichenized fungi that are persistently sterile, and includes species with crustose and fruticose thalli (Lendemer & Hodkinson 2013). It is one of the very few lichen genera in which all species are always sterile and have totally lost the capacity for sexual reproduction (e.g., Ekman & Tønsberg 2002; Lendemer 2011a, 2013a, b; Lendemer & Hodkinson 2013; Guzow-Krzemińska et al. 2019). Their thalli are simple in structure and always consist of soredia-like granules, which in some species are produced on hypothalline hyphae or on short pseudopodetia, or lie directly on the substrate (Lendemer 2011a; Lendemer & Hodkinson 2013). All species produce various secondary lichen metabolites, which are important as characters for identification of *Lepraria* species (e.g., Laundon 1992; Tønsberg 1992; Kukwa & Flakus 2009; Saag et al. 2009; Lendemer 2011a, 2013a, b). However, neither morphology nor lichen substances can be used alone when determining *Lepraria* species, because the same or very similar morphology and various compositions of lichen metabolites have appeared several times in the phylogeny of *Lepraria* (Ekman & Tønsberg 2002; Lendemer 2011a; Lendemer & Hodkinson 2013; Guzow-Krzemińska et al. 2019). In some cases only molecular data have enabled recognition of distinct phylogenetic lineages representing semi-cryptic species (Lendemer 2011a; Guzow-Krzemińska et al. 2019).

In this paper a new species of *Lepraria* containing divaricatic acid is described based on differences in morphology and chemistry from other taxa producing this substance.

## Material and methods

The material of the new species is deposited in B herbarium. Measurements of granules and hyphae were taken in water. Ethanol was added when measuring granule size; it reduced the hydrophobicity of the thallus caused by the lichen metabolites, making all structures easier to observe, without changing the dimensions of thallus structure (see also Olszewska et al. 2014). The secondary lichen substances were studied by thin-layer chromatography (TLC) on glass plates, following the methods presented by Orange et al. (2001). The presence of divaricatic acid was verified by running the extracts from *L. juanfernandezii* adjacent to an extract containing this substance obtained from *Parmeliopsis ambigua*.

## Taxonomy

*Lepraria juanfernandezii* Kukwa, sp. nov. (Fig. 1)

MycoBank MB 831988

**Diagnosis:** The species differs from all other divaricatic acid-containing species of *Lepraria* by the following combination of characters: aggregate thallus with sparse prothallus hyphae, the absence of a hypothallus, the absence of zeorin, and occurrence in the Southern Hemisphere.

**Type:** Chile, Juan Fernández Islands, Robinson Crusoe Island (Más a Tierra), near Bahía de Cumberland, Caves of the

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Figure 1. *Lepraria juanfernandezii* (part of holotype). Scale bar: 500  $\mu$ m.

Expelled, on saxicolous bryophytes, 19 Feb. 1955, G. Kunkel 336b/23 (B 600071742 – holotype!).

**Description.** Thallus crustose, leprose, aggregated, discontinuous or continuous, not stratified, greenish grey. Hyphae hyaline, 1.5–2.5  $\mu$ m in width, septate. Prothallus persistent, poorly developed, visible as hyphae at the edge of some granules. Hypothallus and rhizohyphae absent. Granules globose, 25–45  $\mu$ m in diameter, ecorticate, with outer part consisting of incomplete layer of hyphae (~2  $\mu$ m in width) and incrustated with crystals soluble in K; granules often forming compound units up to 70  $\mu$ m in diam. Photobiont green, coccoid; cells globose, 8–12  $\mu$ m in diameter.

**Chemistry.** Divaricatic acid.

**Etymology.** The new species is named after the archipelago of the Juan Fernández Islands, where it was found.

**Habitat and distribution.** So far it has been found on saxicolous bryophytes at only one locality in the Archipelago of the Juan Fernández Islands.

**Remarks.** Divaricatic acid is a secondary metabolite known in seven *Lepraria* species (including the newly introduced species in this paper) distributed on several continents. The best and most widely known is *L. incana*, which has been reported from numerous localities throughout the world (e.g., Laundon 1992; Tønsberg 1992; Kukwa 2006; Flakus & Kukwa 2007; Flakus et al. 2011a, b, 2015; Saag et al. 2009; Bungartz et al. 2013; Lendemer 2011a, 2013a). However, recent molecular studies by Lendemer (2011a) and Guzow-Krzemińska et al. (2019) showed that several allopatric lineages were hidden under that name. This resulted in the description of *L. hodkinsoniana* and *L. pacifica*, two species from North America (Lendemer 2011a). However, the picture seems to be more complex, and some more unrecognized species may exist within the complex of divaricatic acid-containing *Lepraria*, necessitating more studies (Bungartz et al. 2013; Guzow-Krzemińska et al. 2019). Molecular work narrowed the concept of *L. incana* s.str., which has seemed to be restricted to Europe (Lendemer 2011a; Guzow-Krzemińska et al. 2019) but perhaps occurs also in Asia

and North Africa (Kukwa unpubl.). It has been found that differences in morphology and secondary chemistry, when combined with different distribution ranges, may indicate distinct species (Lendemer 2011a; Guzow-Krzemińska et al. 2019). In view of this, *L. juanfernandezii*, which differs morphologically and/or chemically from all other species containing divaricatic acid, is described as a new species despite the lack of molecular data.

*Lepraria juanfernandezii* is characterized by having an aggregate thallus with sparse prothallus hyphae, the absence of a hypothallus, the presence of divaricatic acid, the absence of zeorin, and occurrence in the Southern Hemisphere. *Lepraria incana* s.str., *L. hodkinsoniana* and *L. pacifica* are three divaricatic acid-containing species with very similar thallus morphologies, but they differ in having zeorin and in having Northern Hemisphere distribution ranges: Europe, eastern North America and western North America, respectively (Lendemer 2011a, 2013a). Further out-of-range reports were published by Bungartz et al. (2013) as *L. aff. incana* from the Galapagos Islands, and by Guzow-Krzemińska et al. (2019) as *L. aff. hodkinsoniana* from South America; those records may represent as-yet undescribed species, but more data are needed to establish their identity. They do not belong to *L. juanfernandezii* because they contain zeorin (Bungartz et al. 2013; Guzow-Krzemińska et al. 2019).

Two other divaricatic acid-containing species, *L. cryophila* and *L. yunnaniana* (syn. *L. nigrocincta*), also lack zeorin. *Lepraria cryophila* contains nordivaricatic acid at a high concentration and differs further in its placodioid thallus type and in occurring only in North America (Lendemer 2011a, 2013a). *Lepraria yunnaniana* produces only a trace amount of nordivaricatic acid, but this species develops a placodioid thallus with a distinctly dark and thick hypothallus and also dark rhizohyphae (Aptroot et al. 1997; Laundon 2008; Saag et al. 2008; Kukwa & Flakus 2009; Lendemer 2011a). This species is widely distributed in the tropics (Aptroot et al. 1997; Kukwa 2006; Laundon 2008; Saag et al. 2009; Kukwa & Flakus 2009; Flakus et al. 2015).

*Lepraria crassissimima*, which may sometimes lack zeorin, differs in its placodioid thallus type with a well-developed hypothallus and abundant rhizohyphae, the presence of nordivaricatic acid usually at a high concentration, and its European distribution (Ekman & Tønsberg 2002; Kukwa 2002, 2006; Saag et al. 2009; Lendemer 2010).

Two specimens of *L. juanfernandezii* are deposited in B. These were both collected at the same locality and with the same collection (locality?) number of G. Kunkel. The label of the holotype has information written in German ('Grotten der Verbannten, nahe der Bahía de Cumberland, auf Massa Tierra, Kleine hellere Grotte') which was translated into English; the other one has all the locality details written in English (Juan Fernández Islands, Caves of the Expelled near Bahía de Cumberland). The notes in the two envelopes are also in different handwriting. It is not clear if they represent the same specimen divided into two fragments, or if they are two specimens collected at the same locality. The

second (smaller) one is therefore cited as additional to the examined holotype.

**Additional specimen examined.** CHILE. Juan Fernández Islands, Caves of the Expelled near Bahía de Cumberland, 19 Feb. 1955, G. Kunkel (B 600126261).

### Key to *Lepraria* species containing divaricatic acid

- 1 Zeorin present ..... 2  
 Zeorin absent ..... 5
- 2(1) Thallus placodioid, nordivaricatic acid often present at high concentration; known from Europe .....  
 ..... *L. crassissima*  
 Thallus aggregated, nordivaricatic present at low concentration or absent; distribution various. .... 3
- 3(2) Known from Europe ..... *L. incana*  
 Known from North America ..... 4
- 4(3) Known from eastern North America .....  
 ..... *L. hodkinsoniana*  
 Known from western North America ..... *L. pacifica*
- 5(1) Thallus aggregated ..... *L. juanfernandezii*  
 Thallus placodioid ..... 6
- 6(5) Thallus with a thick layer of very loose, distinctly dark rhizohyphae; nordivaricatic acid at low concentration .....  
 ..... *L. yunnaniana*  
 Thallus with white to dirty brownish rhizohyphae; nordivaricatic acid often at high concentration ..... 7
- 7(6) Known from eastern North America .... *L. cryophila*  
 Known from Europe. .... *L. crassissima*

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