

Notes on the circumscription of the lichens *Lecanora leprosa* and *L. sulphurescens* (Lecanoraceae, lichenised Ascomycotina)

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Abstract. *Lecanora leprosa* and *L. sulphurescens* are two commonly misidentified pantropical lichens. A detailed circumscription is presented to help overcome such difficulties. Both species contain a chemosyndrome of chlorodepsidones based on gangaleoidin. The new depsidone chlorolecideoidin (methyl 2,4,9-trichloro-3,8-dihydroxy-1,6-dimethyl-11-oxo-11H-dibenzo[b,e][1,4]-dioxepin-7-carboxylate) has been shown to be a minor component of both species.

Zusammenfassung. *Lecanora leprosa* und *L. sulphurescens* sind zwei häufig fehlbestimmte pantropische Flechten. Eine ausführliche Beschreibung der beiden Arten wird vorgelegt. Beide Arten enthalten ein auf Gangaleoidin basierendes Chemosyndrom von Chlordepsidonen. Das neue Depsidon Chlorlecideoidin (Methyl 2,4,9-Trichlor-3,8-dihydroxy-1,6-dimethyl-11-oxo-11H-dibenzo[b,e][1,4]-dioxepin-7-carboxylat) wird beschrieben. Es kommt in beiden Arten als Nebeninhaltsstoff vor.

The tropical species of the *Lecanora subfusca* group are poorly known. While studying the Australasian members of this group, we soon realized that many specimens were misidentified with the collective names *L. leprosa* or *L. sulphurescens*. A number of these specimens, however, belong to different, similar species. *Lecanora leprosa* and *L. sulphurescens* are described here in some detail to clarify the circumscription of the species, including the secondary chemistry, which is an important character in the

distinction of these taxa. Moreover, a new substance, chlorolecideoidin, was detected in most specimens of both species and is described here.

Material and Methods

Specimens were studied from the following herbaria: B, BRI, C, CBG, COLO, DNA, ESS, G, GZU, H, HO, LD, M, MEL, NSW, PC, PERTH, S, TNS, U, UPNG, UPS, WELT, ZT and the

private herbarium of H.T. Lumbsch (Essen).

Microscopy. Thalli and apothecia were cut using a freezing microtome into sections 16-20 μm in thickness and either examined *in situ* or stained with lactophenol cottonblue.

Chemistry. The chemical constituents were identified using thin layer chromatography (Culberson 1972, Culberson et al. 1981, Culberson & Johnson 1982) and high performance liquid chromatography (Feige et al. 1993).

Synthesis of Chlorolecideoidin. A solution of sulphuryl chloride (0.26 ml) in anhydrous dioxan (25 ml) was added dropwise to a stirred solution of lecideoidin (0.5 g) in anhydrous dioxan (25 ml) at room temperature, and stirring continued for 24h. The solvent was then evaporated under reduced pressure and the residue crystallized from ethyl acetate to give chlorolecideoidin (45%) as colourless needles, m.p. 234° C (Found: mol. wt, 431.9572 C₁₇H₁₁³⁵ClO₇ requires mol. wt, 431.9570). ¹H n.m.r. (CDCl₃) 2.41, 2.43, 2s, ArMe; 3.85, s, CO₂Me; 10.51, s, OH. Mass spectrum m/z 436 (3%), 434 (12), 432 (M, 11), 402 (11), 400 (13), 399 (14), 397 (20), 367 (15), 365 (27), 339 (7), 337 (10), 325 (10), 187 (12), 186 (13), 149 (14), 105 (61), 67 (100).

The species

Lecanora leprosa Fée

Essai sur les Cryptogames des Écorces Exotiques Officinales: 118 (1824). - Type: Brazil, Rio de Janeiro, *Glaziou 1921* (PC-FÉE - neotype, herewith selected).

Thallus corticolous, crustose, uniform, adnate, continuous or disperse verrucose to verruculose, yellowish-white to yellowish grey, epruinose. Soredia absent. Margins definite. Prothallus absent or sometimes whitish-grey.

Apothecia immersed when young, later becoming sessile, 0.2-0.7 (-1.1) mm diam., discs light orange to yellowish brown, epruinose or slightly pruinose, margins concolorous with the thallus, thin to thick, entire, sometimes slightly verrucose, later thin to disappearing. Cortex hyaline, more or less gelatinous, inspersed, distinct, 10-15 μm laterally, up to 25 μm at base. Amphithecium

with large, Pol + crystals (=pulicaris type according to Brodo 1984). Parathecium with small Pol + crystals, not disappearing in KOH, 10-15 μm thick. Epithemium not pigmented or yellowish pigmented, with small Pol + bright yellow crystals, which disappear in KOH, 10-15 μm tall (=chlarotera type according to Brodo 1984). Hymenium hyaline, 55-75 μm high. Hypothecium hyaline or yellowish to yellowish brown. Paraphyses ca. 1.5 μm thick, septate, apically weakly ramified and slightly thickened (up to 2.5 μm). Asci clavate, 50-70 x 10-15 μm , 8-spored. Spores narrowly ellipsoid, 9.5-13.5 x 5.0-7.0 μm .

Chemistry: Atranorin and gangaleoidin as major; chloroatranorin and norgangaleoidin as minor substances and chlorolecideoidin and leoidin in traces.

Nomenclature: Here we follow the selection of the lectotype by Vainio (1890), who mentioned Fée collection no. 1921 as authentic material. Brodo (1984) pointed out that this specimen is a poor choice for a lectotype because the specimen includes a reference to Fée's original publication, although it agrees well with the current concept of the species. It cannot be considered as a lectotype since it was probably not available to Fée when he described the new species. However, since apparently no other authentic material is available, the specimen in PC-Fée is here selected as neotype of *L. leprosa*.

Lecanora leprosa is a pantropical species. It is very common in tropical parts of both North and South America, Asia (Wei 1991) and in Africa. In Australia, however, it seems to be quite rare. In mangroves in Northern and Eastern Australia *L. leprosa* is replaced by a superficially similar species, *L. helva* Stizenb. The latter differs from *L. leprosa* in the rough thallus surface, a blackish prothallus and the presence of the 2'-O-methylperlatolic acid instead of the gangaleoidin chemosyndrome. This species is very common in Australia, especially in mangroves and has been commonly misidentified as *L. leprosa* (e.g. by Hafellner et al. 1989). *L. helva* seems to be restricted to the Southern Hemisphere, where it is known from Southern Africa and Australia.

Other superficially similar corticolous species with orange apothecia and yellowish-white to yellowish grey thalli include *L. louisianae* B. de Lesd. and *L. subflava* Tuck. in Nyl., but these species can be readily distinguished by the presence of chloroxanthenes instead of the gangaleoidin chemosyndrome, as well as other morphological characters. These species will be discussed in detail elsewhere.

Selected specimens examined: **Australia - New South Wales:** Patonga, sea level, 19.1.1978, *N. Stevens* (BRI-491272). - **Queensland:** Brisbane, in the city near the Brisbane River, 27°26'S, 153°03'E, 50 m alt., 2.1988, *A. & M. Aptroot 21704* (hb. Aptroot). - Moreton Bay, Coochiemudlo Island, W of N Stradbroke Island, 27°38'S, 153°19'E, mangrove, 30.8.1984, *G.H. Bell 934* (AD-22430). - Port Alma, sea level, 10.6.1975, *R.W. Rogers 794* (BRI-491674). - Port Curtis Distr., 23°03'S, 151°46'E, 19.1.1985, *E. Youman* (BRI-476443), Wreck Island, 23°02'S, 151°58'E, 16.1.1985, *E. Youman 38* (BRI-476440). - Brampton Island, 20°49'S, 149°17'E, 8.8.1974, *J.M. Gilbert* (HO-62256). - **Papua New Guinea:** Central Province, Motupore Island, Bootless Bay, 12 km SE of Port Moresby, 9°32'S, 147°16'E, 1 m alt., 22.2.1987, *H. Sipman 21830, 21853* (B). - **Cook Island:** Maungatea Mtn., 6.1929, *H.E. Parks & S.T. Parks 22548e* (COLO-S-18215). - **Tonga:** Tongatabu Island, 6.1926, *W.A. Setchell 45* (COLO-S-18218). - **Moçambique:** Sul do Save, Distr. Lourenço Marques, 8 km E of Impamputo, 18.10.1953, *O. Almborn 7038* (LD), Botanical Garden in Lourenço Marques, 19.10.1953, *O. Almborn 7189* (LD). - **Tanzania:** Mountain between Moshi and Himo, ca. 900 m alt., 17.12.1978, *Schüz* (STU). - **South Africa:** Natal, Distr. Inanda, Umhlanga Rocks, 14.11.1953, *O. Almborn 9715* (LD). **USA - Hawaii:** Oahu, Waianae Mts, Kolekole Pass, 1600 ft., 22.6.1979, *C.W. Smith 4786* (hb. Lumbsch).

***Lecanora sulphurescens* Fée**

Bull. Soc. Bot. Fr. **20:** 313 (1873). - Type: Brazil, Rio de Janeiro, *Glaziou 3850* (UPS - lectotype).

Thallus saxicolous, crustose, uniform, adnate, continuous or rimose-areolate, yellowish-white to yellowish grey, epruinose. Soredia absent. Margins definite. Prothallus absent.

Apothecia immersed when young, later subimmersed to slightly sessile, 0.3-0.6 (-1.1) mm diam., discs light orange to yellowish brown, epruinose or slightly pruinose, margins concolorous with the thallus, thin to thick, entire. Cortex hyaline, more or less gelatinous, inspersed, distinct, 10-15 µm laterally, up to 20 µm at base. Amphithecium with large, Pol + crystals (=pulicaris type according to Brodo 1984). Parathecium with small Pol + crystals, disappearing in KOH, 10-15 µm thick. Epithymenium orange brown to olive brown pigmented, with small Pol + bright yellow crystals also present in the upper parts of the hymenium which do not disappear in KOH, 15-20 µm tall. Hymenium hyaline, 60-75 µm high. Hypothecium hyaline. Paraphyses ca. 2 µm thick, septate, apically weakly ramified and slightly thickened (up to 3.0 µm). Asci clavate, 40-55 x 10-17.5 µm, 8-spored. Spores ellipsoid to narrowly ellipsoid, 10.0-13.5 x 5.5-7.5 µm.

Chemistry: Atranorin, gangaleodin and leoidin as major; chloroatranorin as minor substance and chlorolecideoidin as well as unidentified fatty acids in traces.

Lecanora sulphurescens is characterized by the subimmersed apothecia, the constant presence of the gangaleoidin chemosyndrome and the saxicolous habitat, as well as the epithymenium with small KOH-insoluble crystals and pulicaris-type amphithecium. Vänškä (1986) placed *L. depressa* Fée into synonymy with *L. sulphurescens*. The holotype of *L. depressa* (Brazil, Rio de Janeiro, *Glaziou 3293b*, C-lectotype, selected by Vänškä 1986), however, differs in having dark brown, completely immersed, discs as well as in lacking the gangaleoidin chemosyndrome, and is therefore considered to be a different species. The morphologically similar *L. plumosa* Müll. Arg. seems to be restricted to Australia. This latter species, however, differs in having sessile, non-immersed apothecia and the presence of the 2'-O-methylperlatolic acid chemosyndrome instead of gangaleoidin. For the synonymy of *L. sulphurescens* see Lumbsch (1992).

Lecanora sulphurescens has a pantropical distribution and is known from Africa, South America and Australasia. It seems to be rather rare in Australia.

Selected specimens examined: **Australia - Queensland:** Jim Crow Mtn., 25 km NE of Rockhampton, 23°13'S, 150°38'E, 200-300 m alt., 14.2.1986, *G. Rambold 4475, 4483* (M). - Thursday Island (NSW L-4410). - **Papua New Guinea:** Central Province, Varirata Plateau, 22 km E of Port Moresby, 9°27'S, 147°23'E, 3.1987, *A. Aptroot 19041* (hb. Aptroot). - **Cape Verde Islands:** São Tiago, Rui Vaz, ca. 630 m alt., 12.10.1986, *B. Mies 209c, CV-1041* (hb. Lumbsch).

The new substance: Chlorolecideoidin

The HPLC retention time of the new substance present in *L. leprosa* and *L. sulphurescens* indicated that this compound was more hydrophobic than gangaleoidin but less hydrophobic than leoidin. Given that this new compound was biosequentially related to these substances, *O*-methylgangaleoidin or chlorolecideoidin seemed the most likely possibilities. Chromatographic comparisons of extracts of these lichens with a synthetic sample of *O*-methylgangaldehyde (Sargent et al. 1975) established that this compound was dissimilar to the unknown lichen substance. Subsequently we have undertaken the synthesis of chlorolecideoidin and found that the TLC and HPLC behaviour of this compound to be identical with that of the minor, new metabolite present in these lichens.

Chlorolecideoidin was prepared by chlorination of lecideoidin (Chester et al. 1979) with sulphuryl chloride as described above. The standardized chromatographic data for these compounds are listed in Table 1.

Acknowledgements: The authors are grateful to the curators of the cited herbaria for sending us material in their care for examination.

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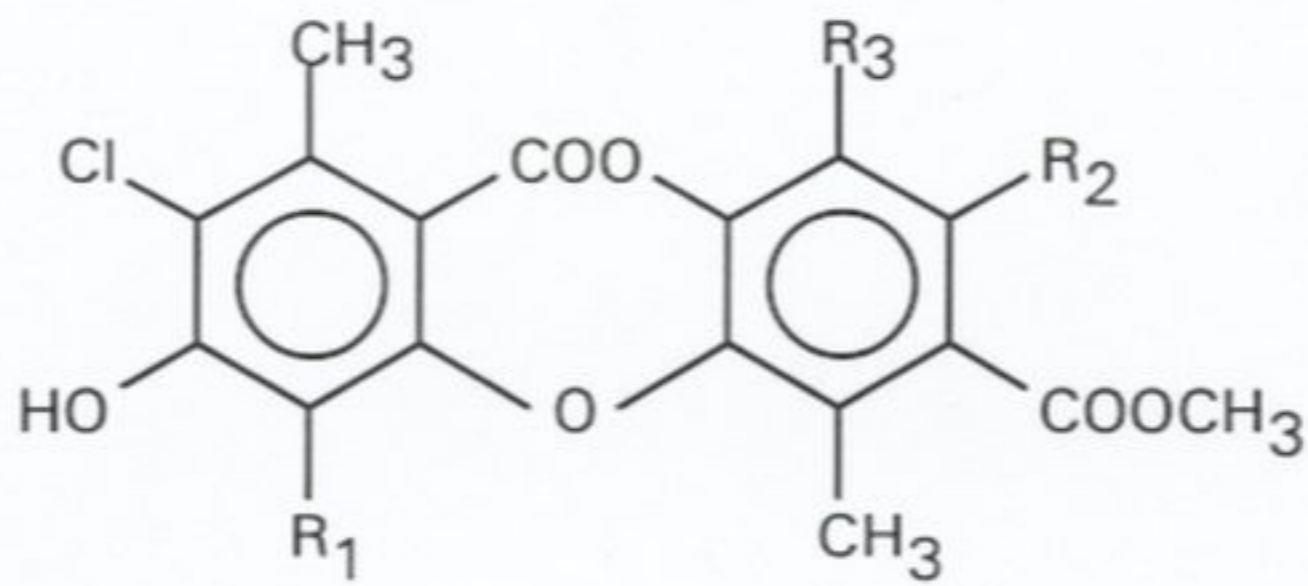


Fig. 1. The Gangaleoidin chemosyndrome

	R ₁	R ₂	R ₃
Gangaleoidin	Cl	OCH ₃	H
Chlorolecideoidin	Cl	OH	Cl
Leoidin	Cl	OH	CH ₃
Norgangaleoidin	Cl	OH	H
Lecideoidin	H	OH	Cl
Dechlorolecideoidin	H	OH	H

Tab. 1. The RF and RI values of the lichen substances present in the treated species.

Substance	A	B'	C	HPLC
Atranorin	75	73	79	38
Chloroatranorin	74	73	81	42
Gangaleoidin	64	40	54	21
Chlorolecideoidin	58	45	48	28
Leoidin	62	54	52	36
Norgangaleoidin	59	40	47	15