Notes on the circumscription of the lichens \textit{Lecanora leprosa} and \textit{L. sulphurescens} (Lecanoraceae, lichenised Ascomycotina)

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Abstract. \textit{Lecanora leprosa} and \textit{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 chlorlecideoidin (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.


The tropical species of the \textit{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 \textit{L. leprosa} or \textit{L. sulphurescens}. A number of these specimens, however, belong to different, similar species. \textit{Lecanora leprosa} and \textit{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, chlorlecideoidin, 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


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. Epihymenium not pigmented or yellowish pigmented, with small Pol + bright yellow crystals, which disappear in KOH, 10-15 µm tall (=chlorotera 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.

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 chloroxanthones instead of the gangaleoidin chemosyndrome, as well as other morphological characters. These species will be discussed in detail elsewhere.


**Lecanora sulphurensis Fée**


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. Epihymenium 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). Ascii 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 in traces.

**Lecanora sulphurensis** is characterized by the subimmersed apothecia, the constant presence of the gangaleoidin chemosyndrome and the saxicolous habitat, as well as the epihymenium with small KOH-insoluble crystals and pulicaris-type amphithecium. Vänskä (1986) placed *L. depressa* Fée into synonymy with *L. sulphurensis*. The holotype of *L. depressa* (Brazil, Rio de Janeiro, Glaziou 3293b, C-lectotype, selected by Vänskä 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. sulphurensis* 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.


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 lipophilic than gangaleoidin but less lipophilic 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*-methylgangaleoidin (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.

**Literature**


Fig. 1. The Gangaleoidin chemosyndrome

<table>
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<th>Substance</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
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<tr>
<td>Gangaleoidin</td>
<td>Cl</td>
<td>OCH₃</td>
<td>H</td>
</tr>
<tr>
<td>Chlorolecideoidin</td>
<td>Cl</td>
<td>OH</td>
<td>Cl</td>
</tr>
<tr>
<td>Leoidin</td>
<td>Cl</td>
<td>OH</td>
<td>CH₃</td>
</tr>
<tr>
<td>Norgangaleoidin</td>
<td>Cl</td>
<td>OH</td>
<td>H</td>
</tr>
<tr>
<td>Lecideoidin</td>
<td>H</td>
<td>OH</td>
<td>Cl</td>
</tr>
<tr>
<td>Dechlorolecideoidin</td>
<td>H</td>
<td>OH</td>
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Tab. 1. The RF and RI values of the lichen substances present in the treated species.

<table>
<thead>
<tr>
<th>Substance</th>
<th>A</th>
<th>B'</th>
<th>C</th>
<th>HPLC</th>
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<tr>
<td>Atranorin</td>
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<tr>
<td>Leoidin</td>
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<td>Norgangaleoidin</td>
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