

## New species of *Pertusaria* (lichenized Ascomycota: *Pertusariaceae*) from the Canary Islands

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**Abstract:** *Pertusaria aceroae* and *Pertusaria calderae* from the Canary Islands are described as new to science. A description of each species is given together with notes on their chemistry, distribution, ecology and taxonomy. Related lichen taxa are discussed.

**Key words:** La Palma, taxonomy, *Pertusariales*

### Introduction

The genus *Pertusaria* DC. has a worldwide distribution with over 350 species, being particularly common in subtropical and temperate regions (Lumbsch & Nash 2002). The genus is characterized by a crustose thallus, hemiangiocarpous apothecia often sunken in verrucae, the presence of a cupulate exciple, primary paraphysoids present in the hamathecium of mature ascomata, thick-walled asci with bivalve dehiscence, and one-celled, often thick-walled, hyaline to brownish ascospores (Lumbsch & Schmitt 2001). The morphological characters show a remarkable variability and, in addition, the chemistry of the genus is very complex.

The genus has received considerable attention during the past few decades, which has resulted in numerous revisions and the description of many new species (Dibben 1980; Hanks 1983; Kantvilas 1990; Archer 1995, 1997, 2004; Lumbsch *et al.* 1999; Zhao *et al.* 2004; Messuti 2005; Sipman

2006; Messuti *et al.* 2007; Zhurbenko & Lumbsch 2006; Lendemer *et al.* 2008; Archer & Elix 2009). Molecular studies have shown that *Pertusaria* is a polyphyletic genus and could be divided into three monophyletic groups (Lumbsch & Schmitt 2001; Schmitt & Lumbsch 2004).

The Macaronesian Islands form part of one of the 25 World Biodiversity Hotspots (Myers *et al.* 2000), and the Canary Islands play a key role within this region (Médail & Quézel 1997, 1999). The lichen biota of the Canary Islands is rich, with *c.* 1500 species listed for an area of just 7447 km<sup>2</sup> (Hernández Padrón 2004). Nevertheless, new records arise and new species continue to be described from the islands with some frequency (Giralt *et al.* 2002; Etayo & Marbach 2003; Elix & Schumm 2003; Hernández Padrón *et al.* 2004; van den Boom & Vězda 2005; van den Boom & Etayo 2006; Pérez-Vargas *et al.* 2007; Giralt & van den Boom 2009; Pérez-Vargas & Pérez de Paz 2009), confirming that the lichen biota in this region with its many ecosystems, is insufficiently known. In the present paper we describe two new species of *Pertusaria* from La Caldera de Taburiente National Park, La Palma.

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### Material and Methods

The specimens were collected from conifers in the high mountains of La Caldera de Taburiente National Park (La Palma) and deposited in CANB, TFC, and the

private herbarium of J. Etayo. The morphology of the lichen specimens was examined using a Leica ZOOM 2000 or a Zeiss Stemi 2000C stereo-microscope. Sections for anatomical examination were cut by hand and examined with an Olympus CH compound microscope. Measurements of well-developed ascospores lying outside the asci were made in water at a magnification of  $\times 1000$ . Colour reactions (spot tests) were made using standard methods (Orange *et al.* 2001). Chemical constituents were identified by thin-layer chromatography using solvent systems A, B' and C (Culberson 1972; Culberson *et al.* 1981; Culberson & Johnson 1982; Elix & Ernst-Russell 1993), high performance liquid chromatography (Elix *et al.* 2003) and by comparison with authentic samples.

### The New Species

#### ***Pertusaria aceroae* Hern.-Padr., Etayo, I. Pérez-Vargas & Elix sp. nov.**

Thallus corticola, crustaceus, flavido-olivaceus, verrucosus; soredia vel isidia nulla. Verrucae fertiles thallo concolores, numerosae. Apothecia disciformia, numerosa, conspicua; disci nigri, plani vel concavi, epruinosi. Epithecium brunneum, K+ violaceum. Hymenium hyalinum. Paraphyses *c.* 2.5  $\mu\text{m}$  crassae. Asci cylindrici, 2-sporei. Ascosporeae hyalinae, non-septatae, ellipsoideae, 125–182  $\times$  53–75  $\mu\text{m}$ . Paries 10–19  $\mu\text{m}$  crassus; thallus acidum thiophanicum, 2,4-dichloro-3-*O*-methylnorlichexanthonum et 2-chloro-6-*O*-methylnorlichexanthonum continens.

Typus: Spain, Canary Islands, La Palma, La Caldera de Taburiente National Park, Barranco Los Guanche, por Tres Venas, UTM: 221900/ 318305, 1930–2000 m alt., on *Juniperus cedrus* Webb & Berthel. in *Pinus canariensis* C. Sm. ex DC. in Buch forest, November 2000, A. Palomares 5321 (TFC Lich—holotypus; CANB, hb. Etayo—isotypi).

(Fig. 1)

*Thallus* crustose, epiphloeodal, rimose to verrucose, moderately thick, greenish yellow, lacking isidia and soredia.

*Apothecia* numerous, rounded to rather irregular, verruciform at first, becoming disciform at maturity, concolorous with the thallus, up to 1 mm diam; *disc* at first immersed finally exposed, concave to flat, black, glossy, not pruinose. *Epithecium* olivaceous, K+ violet. *Hymenium* colourless, 350–400  $\mu\text{m}$  thick. Paraphysoids branched and anastomosed, 2–2.5  $\mu\text{m}$  diam., with small oil drops. *Asci* cylindrical, 275–320  $\times$  70–90  $\mu\text{m}$ . *Ascospores* 2 per ascus, hyaline, ellip-

soid, 125–182  $\times$  53–75  $\mu\text{m}$ ; spore walls thick, 10–19  $\mu\text{m}$ , not or slightly ornamented.

*Pycnidia* not seen.

*Chemistry.* K– or yellowish, C+, KC+ and UV+ vivid orange, P–; containing thiophanic acid (major), 2,4-dichloro-3-*O*-methylnorlichexanthonum (minor) and 2-chloro-6-*O*-methylnorlichexanthonum (minor).

*Etymology.* The specific epithet *aceroae* is derived from the native pre-hispanic name of the area where the new species occurs.

*Notes.* This new species is characterized by its verrucose thallus with exposed, epruinose apothecia, asci with two ascospores with thick walls and the presence of thiophanic acid in addition to several minor chlorinated norlichexanthonones. It superficially resembles the corticolous *Pertusaria paramerae* Crespo & Vězda, an epiphytic species that grows on *Juniperus thurifera* L., in the open juniper woods of the Iberian high plateau (parameras) on the Spanish mainland (Crespo & Vězda 1985). That species, however, has a whitish-grey thallus with the apothecia immersed in fertile soralium-like warts, the 2-spored morphotype has smaller ascospores (95–96  $\times$  53  $\mu\text{m}$ ) and it contains the planaic acid chemosyndrome in addition to the thiophanic acid chemosyndrome.

This new species also resembles *Pertusaria stenhammarii* Hellb., a 2-spored species with disciform apothecia and K+ violet epithecium that grows on bark of conifers at high elevations in Europe and western North America (Dibben 1980; Lumbsch *et al.* 1999), but that species is sometimes sorediate, has shiny-pruinose discs, smaller spores (60–120  $\times$  30–65  $\mu\text{m}$ ) and lacks secondary metabolites (Table 1).

See also Notes under *P. calderae*.

*Habitat and distribution.* *Pertusaria aceroae* occurs on lignum of *Juniperus cedrus* and more rarely *Pinus canariensis*, two endemic conifers present in the highest areas of La Palma. This Canarian pine and cedar forest (*Loto hillebrandii*-*Pinetum canariensis* A. Santos 1983 + *Juniperus cedrus*), which

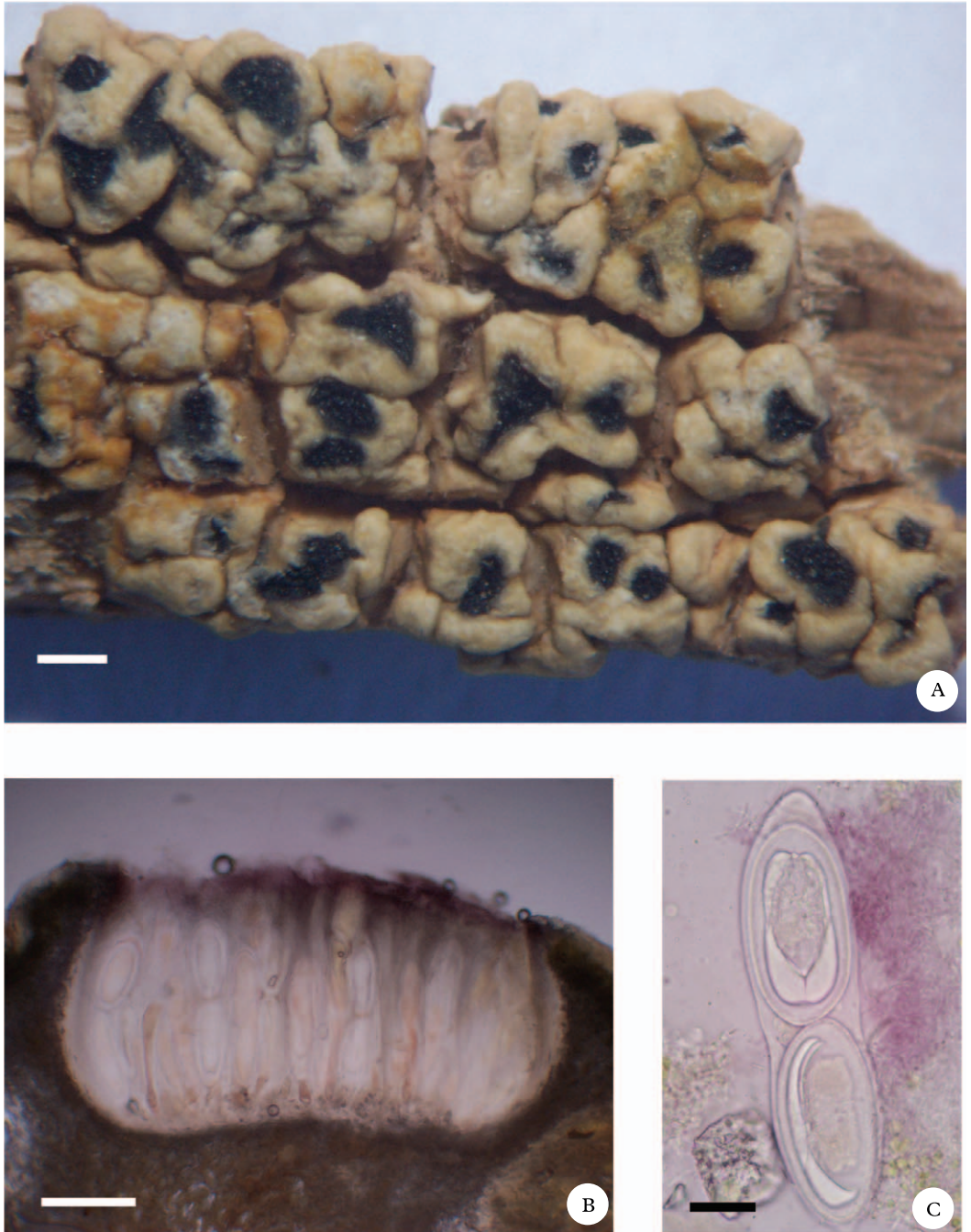


FIG. 1. *Pertusaria aceroae* (part of the holotype). A, habit, showing thallus and apothecia; B, hymenium; C, ascus with spores. Scales: A = 0.5 mm; B = 150  $\mu$ m; C = 100  $\mu$ m.

occurs between 1900–2100 m, is characterized by low forest density and harsh climatic conditions.

*Selected specimens examined. Spain:* Canary Islands: La Palma, La Caldera de Taburiente National Park: Los Andenes, UTM: 2100 m alt., on *f. cedrus*, July 1999, *A. Rebolé* (TFC Lich: 2485); *ibid.*, Sendero desde el Roque de Los Muchachos, UTM: 218500/ 318393, 2150 m alt., on *f. cedrus*, July 1999, *A. Rebolé* (TFC Lich: 2497); *ibid.*, Barranco Los Guanches, por Tres Venas, UTM: 221900/ 318305, 1930–2000 m alt., on *f. cedrus*, November 2000, *A. Palomares* (TFC Lich: 6009, 6010, 6012); *ibid.*, Punta de los Roques, near mountain hut, 2084 m alt., on *f. cedrus*, December 1999, *f. Etayo* s.n. & *M. Martin* (hb. Etayo).

***Pertusaria calderae* Hern.-Padr.,  
Etayo, I. Pérez-Vargas & Elix sp. nov.**

Thallus corticola, crustaceus, flavidus vel olivaceus, rimosus vel verrucoso-areolatus; isidiis et sorediis destitutis. Verrucae fertiles thallo concolores, numerosae. Apothecia disciformia, numerosa, conspicua; disci nigri, albopruinosi. Hymenium hyalinum, epithecium brunneum, K+ violaceum. Paraphyses c. 3 µm crassae. Asci cylindrici. Sporae singulae, ellipsoideae, laeves, 142–187 µm longae, 52–98 µm latae, parietibus (5–)7–9 (–12) µm crassis. Thallus acidum thiophanicum, 2,4-dichloro-3-O-methylnorlichexanthonum et 2-chloro-6-O-methylnorlichexanthonum continens.

Typus: Spain, Canary Islands, La Palma, La Caldera de Taburiente National Park, Barranco Los Guanche, por Tres Venas, UTM: 221900/ 318305, 1930–2000 m alt., on *Juniperus cedrus* in *Pinus canariensis* forest, November 2000, *A. Palomares* 4080 (TFC Lich-holotypus; CANB, hb. Etayo—isotypi).

(Fig. 2)

*Thallus* corticolous, crustose, epiphloeodal, rimose, thin or somewhat thickened, greenish yellow, lacking isidia and soredia.

*Apothecia* conspicuous, numerous and crowded, concolorous with the thallus, 0.75–1.2 mm diam., verruciform at first, becoming disciform at maturity; *disc* concave to flat, black, white pruinose. *Epithecium* olivaceous, K+ violet. *Hymenium* colourless, 200–300 µm thick. Paraphysoids branched and anastomosed, up to 3 µm diam., with oil droplets. *Asci* cylindrical, 190–225 × 55–75 µm; *ascospores* 1 per ascus, hyaline, ellipsoid, 142–187 × 52–98 µm; walls (5–) 7–9 (–12) µm thick, not ornamented.

*Pycnidia* not seen.

*Chemistry.* K– or yellowish, C±, KC± orange and UV± pinkish orange, P–; containing thiophanic acid (major), 2,4-dichloro-3-O-methylnorlichexanthone (minor) and 2-chloro-6-O-methylnorlichexanthone (minor).

*Etymology.* In 1815 the German geologist Leopold von Buch visited La Caldera de Taburiente (La Palma) and other islands in the Canary Archipelago. When he published his memoirs, he introduced the term “caldera” into the geological vocabulary. The specific epithet *calderae* derived from the name of the spectacular orographic feature where this species occurs.

*Notes.* This new species is characterized by its rimose thallus with exposed, pruinose apothecia, single spored asci and the presence of thiophanic acid and several minor chlorinated norlichexanthones.

*Pertusaria calderae* resembles the corticolous *P. hymenea* (Ach.) Schaer. present in temperate Europe and western North America, with its apotheciid ascomata, black, pruinose exposed discs and dark K+ violet epithecium but the latter differs in having a greyish, often continuous thallus, 8-spored asci, smaller spores (60–130 × 25–50 µm) and contains gyrophoric acid in addition to thiophanic acid.

This new species also resembles the 1-spored morphotype of *P. paramerae*. *Pertusaria calderae*, however, is distinguished by having apothecia that are never soralium-like, a greenish yellow rather than whitish grey thallus and by its chemical composition. A further similar corticolous species is the Mediterranean *P. caesia* (Flot.) Nyl., but the latter has a white thallus, larger ascospores (180–220 × 75–100 µm) and a different chemistry (thiophanic and 2-O-methylperlatolic acids).

The new species is chemically identical to *P. aceroae* described above. Although these two species appear to be very closely related, they are morphologically different. In particular *P. calderae* is a monospored species, and *P. aceroae* has 2-spored asci. That, in itself, might not constitute sufficient reason to regard them as separate (e.g., *P. paramerae*

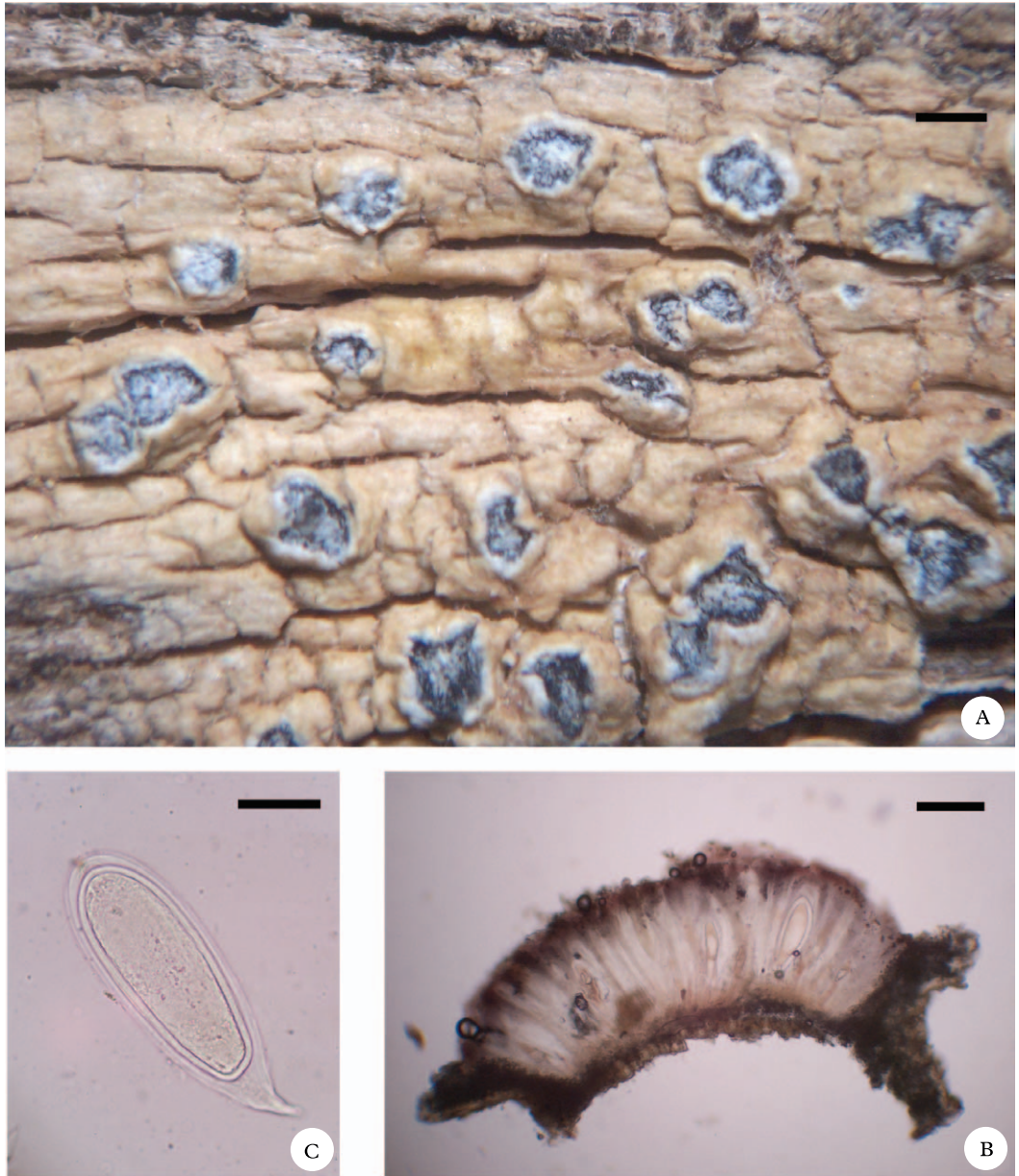


FIG. 2. *Pertusaria calderae* (part of holotype). A, habit, showing thallus and apothecia; B, hymenium; C, ascus with spores. Scales: A = 1 mm; B = 150  $\mu$ m; C = 100  $\mu$ m.

has one- and two-spore morphotypes), but in the case of *P. aceroae* and *P. calderae*, there are many correlated morphological differences. *Pertusaria aceroae* has a moderately thick and verrucose thallus whereas the thal-

lus of *P. calderae* is thin and rimose. In both species the ascomata are finally apothecioid with exposed disc, but in *P. aceroae*, they are sessile to slightly emergent and verrucose, and in *P. calderae* they are almost immersed,

barely emerging from the thallus. The apothecial disc in *P. calderae* is always pruinose; in *P. aceroae* it is epruinose, black and shiny. *Pertusaria aceroae* has a higher hymenium than *P. calderae* (350–400 µm vs 200–300 µm). The asci are larger in *P. aceroae*: 275–350 µm tall compared to 190–225 µm in *P. calderae* (Table 1). Although the spore size is similar, the spore walls are thicker in *P. calderae* than in *P. aceroae*. No intermediate morphotypes were found.

*Habitat and distribution.* *Pertusaria calderae* occurs on lignum of *Juniperus cedrus* in the highest zones of La Caldera de Taburiente National Park (La Palma), between 1700–2400 m, with similar ecology to *P. aceroae* described above.

*Selected specimens examined. Spain:* Canary Islands: La Palma, La Caldera de Taburiente National Park: Veta los Pinos, 1700 m alt., on *J. cedrus*, July 1999, *A. Rebolé* (TFC Lich: 4085); *ibid.*, Inmediaciones Pico de la Cruz, 2050 m alt., on *J. cedrus*, July, 1999, *A. Rebolé* (TFC Lich: 2665); *ibid.*, Barranco Los Guanche, por Tres Venas, UTM: 221900/318305, 1930–2000 m alt., *J. cedrus*, November 2000, *A. Palomares* (TFC Lich: 4084, 6011); *ibid.*, Bajo el Espigón del Roque, UTM: 218570 318384, 2400 m alt., on *J. cedrus*, January 2004, *C. Hernández & P.L. Pérez de Paz* (TFC Lich: 5347, 6016); *ibid.*, Punta de los Roques, near mountain hut, 2084 m alt., on *J. cedrus*, December 1999, *J. Etayo* 17555 & *M. Martín* (hb. Etayo).

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