

***Pertusaria etayoi* (lichenized Ascomycota: *Pertusariaceae*), a new lichen species from the Canary Islands**

**Israel PÉREZ-VARGAS, Consuelo HERNÁNDEZ-PADRÓN and
Pedro L. PÉREZ DE PAZ**

Abstract: *Pertusaria etayoi*, found on lava flows and basaltic rocks from the Canary Islands, is described as new to science. It is the only species in the group of saxicolous *Pertusaria* with verruciform apothecia and 2 rough-walled ascospores to contain thiophaninic acid. A description of the species is given together with notes on its chemistry, distribution, ecology and taxonomy. Possible related lichen taxa are discussed briefly.

Key words: Macaronesia, biodiversity, taxonomy, *Pertusariales*

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Introduction

The genus *Pertusaria* DC. has a worldwide distribution with over 350 species and is 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). Nevertheless, the morphological characters show a remarkable variability and, in addition, the chemistry is very complex.

The genus has received considerable attention in recent decades. This has resulted in numerous revisions and the description of many new species (Dibben 1980; Hanks 1983; Kantvilas 1990; Archer 1997, 2004; Lumbsch *et al.* 1999; Zhao *et al.* 2004; Messuti 2005; Sipman 2006; Archer *et al.* 2009, Archer & Elix 2011). Molecular studies have shown that *Pertusaria* is a polyphyletic genus which

can be separated into three monophyletic groups (Lumbsch & Schmitt 2001; Schmitt & Lumbsch 2004).

The Canary Islands are part of Macaronesia, one of the 25 World Biodiversity hotspots (Myers *et al.* 2000), and play a key role within this region (Médail & Quézel 1997, 1999). The lichen biota of the Canary Islands is rich, with more than 1600 species listed for an area of just 7447 km² (Hernández Padrón & Pérez-Vargas 2009). Nevertheless, new records arise and new species continue to be described from this region with some frequency (Giralt *et al.* 2002; Elix & Schumm 2003; Etayo & Marbach 2003; Pérez-Vargas *et al.* 2007, 2010a, 2011; Giralt & van den Boom 2009, 2011; Pérez-Vargas & Pérez de Paz 2009), including *Pertusaria* (Pérez-Vargas *et al.* 2010b), confirming that the lichen biota in this region, with its many ecosystems, is still insufficiently known. In the present work we describe a new species of *Pertusaria* from this Archipelago.

Material and Methods

The specimens were collected on lava flows in Timanfaya National Park (Lanzarote) and in Fuerteventura. Specimens are deposited in TFC herbarium. The morphology of the lichen specimens was examined using a Leica ZOOM 2000 or a Zeiss Stemi 2000C stereomicroscope. Sections for anatomical examination were

I. Pérez-Vargas, C. Hernández-Pradrón and P. L. Pérez de Paz: Departamento de Biología Vegetal (Botánica), Facultad de Farmacia, Universidad de La Laguna, Astrofísico Sánchez s/n C.P. 38071, La Laguna, Tenerife, Canary Islands, Spain. Email: ispeva@ull.es



FIG. 1. *Pertusaria etayoi*, habit showing thallus and apothecia (part of holotype TFC Lich: 9642) Scale = 2 mm.
In colour online.

cut by hand and were studied with an Olympus CH compound microscope. Spore measurements were made on material mounted in water at $\times 1000$ magnification, and only well-developed ascospores lying outside the asci were measured. Colour reactions (spot tests) were made using standard methods (Orange *et al.* 2001). Chemical constituents were identified by thin-layer chromatography (TLC) using standard methods (Culberson 1972; Culberson *et al.* 1981; Elix & Ernst-Russell 1993).

The New Species

***Pertusaria etayoi* Pérez-Vargas & C. Hern.-Padr. sp. nov.**

MycoBank No.: 563523

Fungus saxicolous. Thallus crustaceus, flavido-olivaceus, rimoso-areolatus; soredia vel isidia nulla. Verrucae fertiles thallo concolores, numerosae, conspicua. Hymenium hyalinum, epithecium brunneum K-. Asci cylindrici, 2-sporei. Ascosporae hyalinae, non-septatae, ellipsoideae, $115\text{--}140 \times 55\text{--}70 \mu\text{m}$. Paries $11\text{--}14(18) \mu\text{m}$ crassus. Conidia filiformia, $12\text{--}16 \times 1 \mu\text{m}$. Thallus acidum thiophanicum, acidum sticticum, acidum norsticticum et acidum menegazziaicum continens.

Typus: Spain, Lanzarote Island, Timanfaya National Park, "Entre Montañas Miradero y Señalo", UTM:



FIG. 2. *Pertusaria etayoi*, ascus with spores. Scale = 50 μm .

TABLE 1. Main differences between *Pertusaria etayoi* and related species.

Character	<i>P. etayoi</i>	<i>P. rupicola</i>	<i>P. pluripuncta</i>	<i>P. flavicans</i>
Thallus	Greenish yellow or yellowish grey, slightly pruinose, cracked-areolate	Grey greenish or yellow-green, epruinose, cracked-areolate	Yellow greyish, green greyish, epruinose, cracked-areolate	Yellow greyish, epruinose, cracked-areolate
Ascomata	Apothecia immersed in fertile-warts, conspicuous, finally exposed, often soralium like	Apothecia at maturity, not resembling soralia	Apothecia immersed in fertile-warts, inconspicuous. Disc punctiform. Rare	Absent. True soralia present
Asci	2-spored	(6–) 8-spored	2-spored	
Ascospores	Hyaline, ellipsoid, 115–140 × 55–70 µm. Spore wall double, striate, 11–14 µm	Hyaline, ellipsoid, 70–100 × 30–50 µm. Spore wall double, smooth 10–15 µm	Hyaline or greyish, ellipsoid, 80–140 × 30–60 µm. Spore wall double, striate, 10–15 µm	
Chemistry	Thiophaninic acid, stictic acid, norstictic acid, menegazziaic acid	Thiophaninic acid, stictic acid, norstictic acid, cryptostictic acid, menegazziaic acid (minor), atranorin (minor)	Thiophaninic acid, stictic acid, norstictic acid (minor), cryptostictic acid (minor), constictic acid (minor), hypostictic acid (minor), menegazziaic acid (minor)	Thiophaninic acid, stictic acid, constictic acid, cryptostictic acid, norstictic acid, menegazziaic acid (minor)
Distribution	Canary Islands	Mediterranean Region	Western Europe	Mediterranean Region–Central Europe

624172/3209083, 395 m alt., on basaltic rocks, March 2010, C. Hernández & P. L. Pérez de Paz, TFC Lich: 9642 (TFC Lich.—holotypus; TFMC, MACB—isotypi).

(Figs 1 & 2)

Thallus crustose, saxicolous, cracked-areolate, moderately thick, yellowish grey (creamy) to greenish yellow, slightly whitish pruinose, lacking isidia and soredia.

Apothecia numerous, verruciform, verruciae conspicuous, concolorous with the thallus, hemispherical to subglobose, disc finally exposed, often deformed and resembling soralia, up to 2.5 mm diam. *Epitecium* olivaceous, K-. *Hymenium* colourless, 320–400 µm thick. *Paraphyses* sparingly branched, anastomosed, up to 3 µm thick. *Asci* cylindrical, 270–300 × 70–90 µm. *Ascospores* 2 per ascus, hyaline, ellipsoid, 115–140 × 55–70 µm; spore walls thick, double, 11–14(18) µm, striate.

Pycnidia rare; *conidia* straight, acicular, 12–16 × 1 µm.

Chemistry. K+ yellow-orange, C+, KC+ and UV+ vivid orange, Pd+ orange; thiophanic, stictic, norstictic and menegazziac acids.

Etymology. This new species is named in honour of the Spanish lichenologist Dr J. Etayo, in recognition of his many contributions to Canarian lichenology and for his friendship.

Habitat and distribution. *Pertusaria etayoi* occurs on basaltic rocks and lava flows between 50 and 650 m a.s.l. in Lanzarote and Fuerteventura, the most eastern islands of the Canarian Archipelago. These areas are characterized by a xerophytic shrub-like community (e.g. *Kleinio-Asparagetum pastoriani*, *Euphorbietum balsamiferae*) with low density and harsh climatic conditions due to the low precipitation and high solar radiation. It is better developed on pahoehoe lavas where it occurs together with crustaceous species of *Acarospora* A. Massal., *Aspicilia* A. Massal., *Caloplaca* Th. Fr. and *Ochrolechia* A. Massal., and fruticose species of *Ramalina* Ach.

Notes. This new species is characterized by its saxicolous habit with verruciform, sub-

globose and finally exposed apothecia, asci with 2 ascospores with thick and striate walls and the presence of thiophanic, stictic, norstictic and menegazziac acids. Superficially it can resemble the Mediterranean saxicolous *Pertusaria rupicola* (Fr.) Harm. That species, however, has an epruinose thallus, the apothecia never resemble soralia, the epitecium is K+ violet and when it is fertile has asci with (6–)8 spores with smooth walls (Boqueras & Llimona 2003).

Other saxicolous species of *Pertusaria* with a similar chemistry and morphology include *P. pluripuncta* Nyl. and *P. flavicans* Lamy. The first has an epruinose thallus, the apothecia are rare and consistently punctiform, inconspicuous and immersed in the thallus (Chambers *et al.* 2009). The latter is a sterile species with true soralia and epruinose thallus (Table 1).

Selected specimens examined. **Spain**: Lanzarote Island: Timanfaya National Park, “Montaña Pedro Perico”, UTM: 616445/ 3207695, 170 m alt., on lava flows, v 2010, C. Hernández, I. Pérez-Vargas & P. L. Pérez de Paz (TFC Lich: 10187); “Montaña de Timanfaya”, UTM: 622249/ 3208156, 458 m alt., basaltic rocks, v 2010, C. Hernández, I. Pérez-Vargas & P. L. Pérez de Paz, (TFC Lich: 9987); “Malpais del Bco. del Fuego”, UTM: 620369/ 3207975, 270 m alt., on lava flows, v 2010, C. Hernández, I. Pérez-Vargas & P. L. Pérez de Paz, (TFC Lich: 9380). Fuerteventura Island: “Montaña La Muda”, 650 m alt., on basaltic rocks, iii 1992, P. L. Pérez de Paz, (TFC Lich: 2130).

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REFERENCES

- Archer, A. W. (1997) The lichen genus *Pertusaria* in Australia. *Bibliotheca Lichenologica* **69**: 1–249.
- Archer, A. W. (2004) *Pertusariaceae*. *Flora of Australia* **56A**: 116–172.
- Archer, A. W. & Elix, J. A. (2011, last accessed) A Preliminary World-wide Key to the Lichen Genus *Pertusaria*. http://www.rbgsyd.nsw.gov.au/science/Plant_Diversity_Research/Key_to_Pertusaria
- Archer, A. W., Elix, J. A., Fischer, E., Killmann, D. & Serusiaux, E. (2009) The lichen genus *Pertusaria* (Ascomycota) in Central Africa (Congo/Kivu, Rwanda and Burundi) and Western Kenya. *Nova Hedwigia* **88**: 309–333.
- Boqueras, M. & Llimona, X. (2003) The genus *Pertusaria* (lichenised Ascomycotina) on the Iberian Peninsula

- and Balearic islands. I. Subgenus *Pertusaria*. *Mycotaxon* **88**: 471–492.
- Chambers, S. P., Gilbert, O. L., James, P. W., Aptroot, A. & Purvis, O. W. (2009) *Pertusaria*. In *The Lichens of Great Britain and Ireland* (C. W. Smith, A. Aptroot, B. J. Coppins, A. Fletcher, O. L. Gilbert, P. W. James & P. A. Wolseley, eds): 673–687. London: British Lichen Society.
- Culberson, C. F. (1972) Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* **72**: 113–125.
- Culberson, C. F., Culberson, W. L. & Johnson, A. (1981) A standardized TLC analysis of β -orcinol depsidones. *Bryologist* **84**: 16–29.
- Dibben, M. J. (1980) *The Chemosystematics of the Lichen Genus Pertusaria in North America and North of Mexico*. Milwaukee: Publications in Biology and Geology 5, Milwaukee Public Museum Press.
- Elix, J. A. & Ernst-Russell, K. D. (1993) *A Catalogue of Standardized Thin Layer Chromatographic Data and Biosynthetic Relationships for Lichen Substances*, 2nd Edition. Canberra: Australian National University.
- Elix, J. A. & Schumm, F. (2003) New species and new records in the lichen family Parmeliaceae (Ascomycota) from Macaronesia. *Mycotaxon* **86**: 383–388.
- Etayo, J. & Marbach, B. (2003) *Hafellia alisioae* and *H. gomerana* (lichenized Ascomycetes, Physciaceae), two new species from the Canary Islands, with a key to all known corticolous species. *Lichenologist* **35**: 369–375.
- Giralt, M. & van den Boom, P. P. G. (2009) *Rinodina etayoi*, a new saxicolous lichen species from the Canary Islands. *Lichenologist* **41**: 141–145.
- Giralt, M. & van den Boom, P. P. G. (2011) The genus *Buellia* s. l. and some additional genera of Physciaceae in the Canary Islands. *Nova Hedwigia* **92**: 29–55.
- Giralt, M., Etayo, J. & van den Boom, P. P. G. (2002) *Buellia laurocanariensis*, a new species from the Canary Islands. *Lichenologist* **34**: 203–206.
- Hanko, B. (1983) Die Chemotypen der Flechtengattung *Pertusaria* in Europa. *Bibliotheca Lichenologica* **19**: 1–311.
- Hernández Padrón, C. E. & Pérez-Vargas, I. (2009) Lichenes, lichenicolous fungi. In *Lista de Especies Silvestres de Canarias. Hongos, Plantas y Animales Terrestres*. (M. Archavaleta, S. Rodríguez, N. Zurita & A. García, coord.): 71–105. Gobierno de Canarias, Canary Islands: Consejería de Medio Ambiente y Ordenación Territorial.
- Kantvilas, G. (1990) The genus *Pertusaria* in Tasmanian rainforests. *Lichenologist* **22**: 289–300.
- Lumbsch, H. T. & Nash III, T. H. (2002) *Pertusaria*. In *Lichen Flora of the Greater Sonoran Desert Region. Vol. 1*. (T. H. Nash III, B. D. Ryan, C. Gries & F. Bungartz, eds.): 341–357. Tempe, Arizona: Lichens Unlimited.
- Lumbsch, H. T. & Schmitt, I. (2001) Molecular data suggest that the lichen genus *Pertusaria* is not monophyletic. *Lichenologist* **33**: 161–170.
- Lumbsch, H. T., Nash III, T. H. & Messuti, M. I. (1999) A revision of *Pertusaria* species with hyaline ascospores in southwestern North America (Pertusariales, Ascomycotina). *Bryologist* **102**: 215–239.
- Médail, F. & Quézel, P. (1997) Hot-Spots analysis for conservation of plant biodiversity in the Mediterranean basin. *Annals of the Missouri Botanical Garden* **84**: 112–127.
- Médail, F. & Quézel, P. (1999) Biodiversity hotspots in the Mediterranean basin: setting global conservation priorities. *Conservation Biology* **13**: 1510–1513.
- Messuti, M. I. (2005) The genus *Pertusaria* (Pertusariales: Pertusariaceae) in the Juan Fernández Archipelago (Chile). *Lichenologist* **37**: 111–122.
- Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* **403**: 853–858.
- Orange, A., James, P. W. & White, F. J. (2001) *Microchemical Methods for the Identification of Lichens*. London: British Lichen Society.
- Pérez-Vargas, I. & Pérez de Paz, P. L. (2009) *Caloplaca chelyae* (Teloschistaceae), a new lichen from the Canary Islands. *Bryologist* **112**: 839–844.
- Pérez-Vargas, I., Hernández-Pradrón, C. & Elix, J. A. (2007) A new species of *Xanthoparmelia* (Ascomycota: Parmeliaceae) from the Canary Islands. *Lichenologist* **39**: 445–449.
- Pérez-Vargas, I., Hernández-Pradrón, C., Pérez de Paz, P. L. & Elix, J. A. (2010a) *Tephromela follmannii* (lichenized Ascomycota) a new species from the Canary Islands. *Mycotaxon* **112**: 9–14.
- Pérez-Vargas, I., Hernández-Pradrón, C., Etayo, J., Pérez de Paz, P. L. & Elix, J. A. (2010b) New species of *Pertusaria* (lichenized Ascomycota: Pertusariaceae) from the Canary Islands. *Lichenologist* **42**: 35–41.
- Pérez-Vargas, I., Hernández-Pradrón, C., Pérez de Paz, P. L. & Elix, J. A. (2011) [“2012”] A new saxicolous species of *Diploschistes* (Thelotremales) from the Canary Islands. *Lichenologist* **44**: 67–71.
- Schmitt, I. & Lumbsch, H. T. (2004) Molecular phylogeny of the Pertusariaceae supports secondary chemistry as an important systematic character set in lichen-forming ascomycetes. *Molecular Phylogenetics and Evolution* **33**: 43–55.
- Sipman, H. J. M. (2006) Compiled identification key to the genus *Pertusaria* and some confusable taxa in Europe and the Mediterranean. Botanischer Garten und Botanisches Museum Berlin-Dahlem, Freie Universität Berlin. <http://www.bgbm.org/sipman/keys/Perteuro.htm>
- Zhao, Z. T., Ren, Q. & Aptroot, A. (2004) An annotated key to the lichen genus *Pertusaria* in China. *Bryologist* **107**: 531–541.