Phytotaxa 175 (5): 281–286
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.175.5.7

The first squamulose *Thelocarpon* species (Thelocarpaceae, Ascomycota) discovered in the biological soil crusts in the Bolivian Andes

ADAM FLAKUS[1*] & MARTIN KUKWA[2]
[1]*Laboratory of Lichenology, W. Szafer Institute of Botany, Polish Academy of Sciences, Lubicz 46, PL–31–512 Krakow, Poland; e-mail: a.flakus@botany.pl*
[2]*Department of Plant Taxonomy and Nature Conservation, University of Gdańsk, Wita Stwosza 59, PL–80–308 Gdańsk, Poland; e-mail: dokmak@ug.edu.pl*
**Corresponding author: a.flakus@botany.pl*

Abstract

Thelocarpon andicola, a new terricolous species from the tropical Andes in Bolivia is described in this paper. This is the first member of the genus with squamulose to placodioid and yellow pruinose thallus, which is further characterized by non-amyloid hymenial gel, branched paraphyses, amyloid asci without visible mass axiale and broadly ellipsoidal ascospores.

Key words: biodiversity, lichenized fungi, Neotropics, Pezizomycotina, South America, taxonomy

Introduction

Thelocarpon Nylander (1853: 318) is represented by about 20 species occurring on soil, wood or rocks, with some species occasionally or commonly being lichenicolous (Magnusson 1936; Salisbury 1966, 1974; Poelt & Vězda 1977; McCarthy & Kantvilas 2009; Orange *et al.* 2009). The genus is currently classified in family Thelocarpaceae, but its precise phylogenetic placement within Pezizomycotina remains still unknown (Reeb *et al.* 2004; Miądlikowska *et al.* 2014). The well-documented high plasticity of ascomata (from perithecioid to apothecioid) and ascus types (with or without axial mass) seem to suggest the polyphyly of *Thelocarpon* (Salisbury 1966, 1974; Poelt & Hafellner 1975), however, the recent molecular study by Lumbsch *et al.* (2009) has finally proved its monophyly.

Thelocarpon is characterized by apothecioid or perithecioid ascomata, which can be yellow-green pruinose in some species due to the presence of pulvinic acid derivatives, by the hamathecium of simple to branched paraphyses (in some species absent) with periphysoids present or not, and flask-shaped, multispored asci containing hyaline, simple or 1-septate ascospores. The genus has also quite diverse nutritional strategy. Some species are clearly lichen-forming and its ascomata are developing in thallus verrucae where the algal sheath is present (sometimes sterile verrucae also contain algal cells), however other species can be fortuitously lichenized or clearly non-lichen-forming (Salisbury 1966; Knudsen & Lumbsch 2007; McCarthy & Kantvilas 2009; Orange *et al.* 2009).

During our ongoing lichenological studies carried out in Bolivia (e.g. Flakus & Wilk 2006; Flakus 2009; Flakus *et al.* 2008, 2011, 2012; Kukwa & Flakus 2009; Kukwa *et al.* 2012, 2013), an undescribed species of *Thelocarpon* was found in the Andes. The species has a unique morphology as it is the first member of the genus with fully lichenized squamulose to placodioid thallus, and it is described below.

Material and Methods

The study based on material collected by the authors and deposited in KRAM, LPB, UGDA, and private herbarium of A. Flakus. The morphology and the anatomy were examined using standard stereo and compound microscopes (Nikon SMZ 800, Nikon Eclipse 80i DIC). Hand sections and squash mounds were examined in tap water, 10% solution of potassium hydroxide (K) or lactophenol cotton blue (LPCB). The amyloidity of lichen structures were studied using

Accepted by Thorsten Lumbsch: 25 Jul. 2014; published: 15 Aug. 2014

Acknowledgements

We are greatly indebted to Dr. Kerry Knudsen (Riverside) and Dr. Sergio Pérez-Ortega (Madrid) for reviewing the manuscript and constructive comments. Special thanks go to Rosa I. Meneses Q., the Director of Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés, La Paz, for generous cooperation. This research received support from the National Centre for Research and Development (NCBiR) in Poland, under the LIDER Programme for the years 2010–2013 (no. 92/L–1/09) and also from the W. Szafer Institute of Botany of the Polish Academy of Sciences through the statutory funds.

References

Awasthi, D.D. (1991) A key to the microlichens of India, Nepal and Sri Lanka. *Bibliotheca Lichenologica* 40: 1–340.

Awasthi, D.D. & Singh, K.P. (1975) Three new taxa of lichens from Palni Hills, India. *Geophytology* 5: 39–42.

Bouly de Lesdain, M. (1914) *Recherches sur les Lichens des Environs de Dunkerque: Premier Supplement*. Imp. P. Michel, Dunkerque, 189 pp.

Culberson, C.F. & Kristinsson, H. (1970) A standardized method for the identification of lichen products. *Journal of Chromatography* 46: 85–93.
http://dx.doi.org/10.1016/s0021-9673(00)83967-9

Eitner, E. (1901) Zweiter Nachtrag zur schlesischen Flechtenflora. *Jahresbericht der Schlesischen Gesellschaft für Vaterländische Kultur* 78: 5–27.

Flakus, A. (2009) *Aspidothelium lueckingii*: a new lichenized fungus from Bolivia. *Nova Hedwigia* 88: 139–143.
http://dx.doi.org/10.1127/0029-5035/2009/0088-0139

Flakus, A. & Wilk, K. (2006) Contribution to the knowledge of the lichen biota of Bolivia. *Journal of the Hattori Botanical Laboratory* 99: 307–318.

Flakus, A., Ahti, T., Kukwa, M. & Wilk, K. (2008) New and interesting records of *Cladonia* and their lichenicolous fungi from the Andean cloud forest in Bolivia. *Annales Botanici Fennici* 45: 448–454.
http://dx.doi.org/10.5735/085.045.0603

Flakus, A., Elix, J.A., Rodriguez, P. & Kukwa, M. (2011) New species and records of *Lepraria* (Stereocaulaceae, lichenized Ascomycota) from South America. *Lichenologist* 43: 57–66.
http://dx.doi.org/10.1017/s0024282910000502

Flakus, A., Rodriguez Saavedra, P. & Kukwa, M. (2012) A new species and new combinations and records of *Hypotrachyna* and *Remototrachyna* from Bolivia. *Mycotaxon* 119: 157–166.
http://dx.doi.org/10.5248/119.157

Flotow, J. (1847) *Sphaeropsis* Fw., eine neue deutsche Flechtengattung. *Botanische Zeitung* 5: 65–66.

Knudsen, K. & Lumbsch, H.T. (2007) *Thelocarpon*. *In*: Nash III, T.H., Gries, C. & Bungartz, F. (Eds.) *Lichen Flora of the Greater Sonoran Desert Region, Volume 3*. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 301–302.

Kocourková-Horáková, J. (1998) Distribution and ecology of the genus *Thelocarpon* (Lecanorales, Thelocarpaceae) in the Czech Republic. *Czech Mycology* 50: 271–302.

Kukwa, M. & Flakus, A. (2009) *Lepraria glaucosorediata* sp. nov. (Stereocaulacae, lichenized Ascomycota) and other interesting records of *Lepraria*. *Mycotaxon* 108: 353–364.
http://dx.doi.org/10.5248/108.353

Kukwa, M., Etayo, J. & Flakus, A. (2012) *Plectocarpon stereocaulicola* (Roccellaceae, Ascomycota), a new lichenicolous fungus from Bolivia. *Lichenologist* 44: 479–482.
http://dx.doi.org/10.1017/s0024282912000151

Kukwa, M., Schiefelbein, U. & Flakus, A. (2013) A contribution to the lichen family Graphidaceae (Ostropales, Ascomycota) of Bolivia. *Herzogia* 26: 231–252.
http://dx.doi.org/10.13158/heia.26.2.2013.231

Lumbsch, H.T., Zimmermann, D.G. & Schmitt, I. (2009) Phylogenetic position of ephemeral lichens in Thelocarpaceae and Vezdaeaceae (Ascomycota). *Bibliotheca Lichenologica* 100: 389–398.

Lutzoni, F., Pagel, M. & Reeb, V. (2001) Major fungal lineages are derived from lichen symbiotic ancestors. *Nature* 411: 937–940.
http://dx.doi.org/10.1038/35082053

Magnusson, A.H. (1936) Acarosporaceae und Thelocarpaceae. *In:* Zahlbruckner, A. (Ed.) *Dr. L. Rabenhorst's Kryptogamen Flora von Deutschland, Öesterreich und der Schweiz, 2nd, Band 9 (5/1)*. Akademische Verlagsgesellschaft M.B.H., Leipzig, pp. 1–318.

McCarthy, P.M. & Kantvilas, G. (2009) Thelocarpaceae. *In*: McCarthy, P.M. (Ed.) *Flora of Australia Volume 57, Lichens 5*. ABRS and CSIRO Publishing, Canberra and Melbourne, pp. 563–569.

Miądlikowska, J., Kauff, F, Högnabba, F., Oliver, J.C., Molnár, K., Fraker, E., Gaya, E., Hafellner, J., Hofstetter, V., Gueidan, C., Otáloraa, M.A.G., Hodkinson, B., Kukwa, M., Lücking, R., Björk, C., Sipman, H.J.M., Burgaz, A.R., Thell, A., Passo, A., Myllys, L., Goward, T., Fernández-Brime, S., Hestmark, G., Lendemer, J., Lumbsch, H.T., Schmull, M., Schoch, C.L., Sérusiaux, E., Maddison, D.R., Arnold, A.E., Lutzoni, F. & Stenroos, S. (2014) A multigene phylogenetic synthesis for the class Lecanoromycetes (Ascomycota): 1307 fungi representing 1139 infrageneric taxa, 317 genera and 66 families. *Molecular Phylogenetics and Evolution* 79: 132–168. http://dx.doi.org/10.1016/j.ympev.2014.04.003

Moon, K.H. & Aptroot, A. (2009) Pyrenocarpous lichens in Korea. *Bibliotheca Lichenologica* 99: 297–314.

Nylander, W. (1853) Lichenes Algerienses novi. *Annales des Sciences Naturelles* 20: 315–320.

Nylander, W. (1855) Essai d'une nouvelle classification des lichens (second mémoire). *Mémoires de la Société Impériale des Sciences Naturelles de Cherbourg* 3: 161–202.
http://dx.doi.org/10.5962/bhl.title.50222

Orange, A., James, P.W. & White, F.J. (2001) *Microchemical methods for the identification of lichens*. British Lichen Society, London, 101 pp.

Orange, A., Watson, M.F., James, P.W. & Moore, D.M. (2009) *Thelocarpon* Nyl. (1853). *In*: Smith, C.W., Aptroot, A., Coppins, B.J., Fletcher, A., Gilbert, O.L., James, P.W. & Wolseley, P.A (Eds.) *The lichens of Great Britain and Ireland*. The British Lichen Society, London, pp. 884–888.

Poelt, J. & Hafellner, J. (1975) Schlauchpforten bei der Flechtengattung *Thelocarpon*. *Phyton* 17: 67–77.

Reeb, V., Lutzoni, F. & Roux, C. (2004) Contribution of RPB2 to multilocus phylogenetic studies of the Euascomycetes (Pezizomycotina, Fungi) with special emphasis on the lichen-forming Acarosporaceae and evolution of polyspory. *Molecular Phylogenetics and Evolution* 32: 1036–1060.
http://dx.doi.org/10.1016/j.ympev.2004.04.012

Salisbury, G. (1953) The genus *Thelocarpon* in Britain. *North Western Naturalist* 1953: 66–76.

Salisbury, G. (1966) A monograph of the lichen genus *Thelocarpon* Nyl. *Lichenologist* 3: 175–196.
http://dx.doi.org/10.1017/s0024282966000197

Salisbury, G. (1974) A monograph of the fungal genus *Ahlesia* Fuckel. *Nova Hedwigia* 25: 683–690.

Vondrák, J., Palice, Z., Khodosovtsev, A. & Postoyolkin, S. (2010) Additions to the diversity of rare or overlooked lichens and lichenicolous fungi in Ukrainian Carpathians. *Chornomorski Botanical Journal* 6: 6–34.