

**ACAROSPORA FUSCATA AND A. UMBILICATA  
(ACAROSPORACEAE, ASCOMYCOTA) IN BELARUS**

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The article presents the results of a revision of herbarium specimens of gyrophoric acid containing *Acarospora* species in Belarus. Two species were recorded, *A. fuscata* and *A. umbilicata*. Morphological and anatomical characters, ecology and distribution of both species are discussed. Our revision sufficiently extended the knowledge about range of *Acarospora umbilicata* in Eastern Europe. For this species, two genes, nrITS and mtSSU, were generated and available through GenBank for further phylogenetic research. Based on a list of 1081 species and infraspecific names we estimated the genus *Acarospora* is currently represented by 307 taxa.

**Key words:** biodiversity, lichen, distribution

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REFERENCES

- Amrani S., Seaward M.R.D., Sipman H.J.M., Feuerer T. 2018. Lichenological exploration of Algeria II: checklist of lichenized, lichenicolous and allied fungi. — *Herzogia*. 31: 817–892.  
<https://doi.org/10.13158/heaia.31.2.2018.817>
- Arcadia L., Knudsen K. 2012. The name *Myriospora* is available for the *Acarospora smaragdula* group. — *Opuscula Philolichenum*. 11: 19–25.
- Arcadia L., Knudsen K., Westberg M. 2015. (2341) Proposal to conserve the name *Lichen fuscatus* Schrad. (*Acarospora fuscata*) against *L. fuscatus* Lam. with a conserved type (lichenised Ascomycota: Acarosporaceae). — *Taxon* 64: 168–169.  
<https://doi.org/10.12705/641.7>
- Berger F., Aptroot A. 2002. Further contributions to the flora of lichens and lichenicolous fungi of the Azores. — *Arquipélago, Life and Marine Sciences*, A. 19: 1–12.
- Egea J.M. 1996. Catalogue of lichenized and lichenicolous fungi of Morocco. — *Bocconea* 6: 19–114.
- Esslinger T. 2019. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, Version 23. — *Opuscula Philolichenum*. 18: 102–378.
- Golubkov V.V. 1992. Lishainiki okhranyayemykh prirodnykh territorii Belarusi (floristicheskaya i ekologo-geograficheskaya kharakteristika) [Lichens of protected natural territories of Belarus (floristic and ecogeographical characteristic)]: Diss. ... Kand. Sci. Minsk. 503 p. (In Russ.).

- Golubkov V.V. 1996. Vliyaniye antropogennoi transformatsii landshaftov na osobennosti rasprostraneniya i raznoobraziya lishainikov v Belorusskom Poozer'e [Influence of anthropogenic transformation of landscapes on the distribution and diversity of lichens in the Belarusian Lakeland]. – In: Sokhraneniye biologicheskogo raznoobraziya Belorusskogo Poozerya. Abstracts of the regional conference. Vitebsk. P. 81–82 (In Russ.).
- Golubkova N.S. 1988. Lishainiki semeistva Acarosporaceae Zahlbr. v SSSR [The lichen family Acarosporaceae Zahlbr. in the U.S.S.R.]. Leningrad. 134 p. (In Russ.).
- Hafellner J. 1993. *Acarospora* und *Pleopsidium* – zwei lichenisierte Ascomycetengattungen (Lecanorales) mit zahlreichen Konvergenzen. – Nova Hedwigia. 56: 281–305.
- Index Fungorum.  
<http://www.indexfungorum.org/names/names.asp>  
 (Accessed 29.09.2021).
- Knudsen K. 2004. A preliminary study of *Acarospora smaragdula* var. *lesdainii* in California. – Opuscula Philolichenum. 1: 21–24.
- Knudsen K. 2007. *Acarospora*. – In: Lichen Flora of the Greater Sonoran Desert Region. Volume 3. Tempe. P. 1–38.
- Knudsen K. 2021. Acarosporaceae. Atlas of Czech lichens (2021). <https://dalib.cz/en/data/info> (Accessed 03.09.2021)
- Knudsen K., Kocourková J. 2017. What is *Acarospora nitrophila* (Acarosporaceae)? – Bryologist. 120 (2): 125–129.  
<https://doi.org/10.1639/0007-2745-120.2.125>
- Knudsen K., Kocourková J. 2018. Two new calciphytes from Western North America, *Acarospora brucei* and *Acarospora erratica* (Acarosporaceae). – Opuscula Philolichenum. 17: 342–350.
- Knudsen K., Kocourková J. 2020. Acarosporaceae of Belarus. – Herzogia. 33: 394–406.  
<https://doi.org/10.13158/hea.33.2.2020.394>
- Knudsen K., Arcadia L., Kocourková J. 2019a. *Acarospora squamulosa*, the correct name for *A. pelioscypha*. – Mycotaxon. 134: 281–287.  
<https://doi.org/10.5248/134.281>
- Knudsen K., Malíček J., Kocourková J. 2019b. The conserved type of *Lichen fuscatus* [≡ *Acarospora fuscata*]. – Mycotaxon. 134: 295–300.  
<https://doi.org/10.5248/134.295>
- Knudsen K., Adams J.N., Kocourková J., Wang Y., Ortañez J., Stajich J.E. 2020. The monophyletic *Sarcogyne canadensis*–*wheeleri* clade, a newly recognized group sister to the European *Acarospora glaucocarpa* group. – Bryologist. 123: 11–30.  
<https://doi.org/10.1639/0007-2745-123.1.011>
- Knudsen K., Kocourková J., Cannon P., Coppins B., Fletcher A., Simkin J. 2021a. Acarosporales: Acarosporaceae, including the genera *Acarospora*, *Caeruleum*, *Myriospora*, *Pleopsidium*, *Sarcogyne* and *Trimmatothelopsis*. – Revisions of British and Irish Lichens. 12: 1–25.
- Knudsen K., Kocourková J., Hodková E., Malíček J., Wang Y. 2021b. Acarosporaceae of the Chihuahuan Desert: four Magnusson species saved from synonymy and a new yellow species. – Bryologist. 124: 533–551.  
<https://doi.org/10.1639/0007-2745-124.4.533>
- Knudsen K., Kocourková J., Hodková E., Malíček J., Wang Y. In Press. Acarosporaceae of New Mexico: ten new species of *Acarospora* and *Sarcogyne*. – Bryologist.
- Magnusson A.H. 1929. A monograph of the genus *Acarospora*. Kungliga Svenska Vetenskaps-Akademiens Handlingar, ser. 3, 7. 400 p.
- Magnusson A.H. 1956. A second supplement to the monograph of *Acarospora* with keys. – Göteborgs Kungliche Vetenskaps- och Vitterhets Samhälles Handlingar ser. B. 6 (17): 1–63.
- Makhnach A.A. 2004. Introduction to geology of Belarus. Minsk. 198 pp.
- McCarthy P.M. 2020. Checklist of the Lichens of Australia and its Island Territories. Australian Biological Resources Study, Canberra. Version 1 March 2020. <http://www.anbg.gov.au/abrs/lichenlist/introduction.html> (Accessed 03.09.2021)
- Nimis P.L. 2016. The Lichens of Italy – a second annotated catalogue. Trieste. 740 p.
- Ohmura Y., Kashiwadani H. 2018. Checklist of lichens and allied fungi of Japan. National Museum of Nature and Science Monographs. 49: 1–140.
- Popiel M., Szczepańska K. 2014. Lichens of the Lubiąż monastery complex. – Acta Botanica Silesiaca. 10: 155–156.
- 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. – Mol. Phylogenet. Evol. 32: 1036–1060.  
<https://doi.org/10.1016/j.ympev.2004.04.012>
- Rodriguez de Flakus P., Kukwa M., Etayo J., Lücking R., Meneses R.I., Rivas Plata E., Stanton D., Truong C., Vargas R., Flakus A. 2016. Preliminary catalogue of lichens and lichenicolous fungi from Bolivia. Version 1.5 (31 December 2016).  
<http://bio.botany.pl/lichens-bolivia/en,strona,catalogue,5.html> (Accessed 03.09.2021)
- Roux C. 2007. Likenoj de Okcidenta Eŭropo. Suplemento 4a: eltirajoj 2 (extraits 2). – Bull. inf. Assoc. fr. lichénol. 32: 5–36.
- Roux C., Poumarat S., Gueidan C., Navarro-Rosinés P., Monnat J.-Y., Houmeau J.-M. 2019. La Acarosporaceae de Okcidenta Eŭropo. – Bull. Soc. Linn. Provence 70: 107–167.
- Sohrabi M., Rico V. 2021. The genus *Acarospora* A. Massal. in Iran. Iranian Research Organization for Science and Technology (IROST).  
<http://www.mycolich.ir/node/234> (Accessed 07.09.2021)
- Tsurykau A. 2018. A provisional checklist of the lichens of Belarus. – Opuscula Philolichenum. 17: 374–479.
- Tsurykau A. 2020. Life forms of lichens in Belarus. – Bot. Zhurn. 105 (6): 523–541.  
<https://doi.org/10.31857/S0006813620040092>
- Tsurykau A., Golubkov V., Bely P. 2018. The lichen genus *Xanthoparmelia* (Parmeliaceae) in Belarus. – Folia Cryptog. Estonica. 55: 125–132.  
<https://doi.org/10.12697/fce.2018.55.13>
- Urbanavichus G. 2010. A checklist of the lichen flora of Russia. St. Petersburg. 194 p. (In Russ.).
- Weber W.A. 1968. A taxonomic revision of *Acarospora*, subgenus *Xanthothallia*. – Lichenologist. 4: 16–31.  
<https://doi.org/10.1017/S0024282968000046>

- Westberg M., Crewe A.T., Purvis O.W., Wedin M. 2011. *Silobbia*, a new genus for the *Acarospora smaragdula* complex (Ascomycota, Acarosporales) and a revision of the group in Sweden. – *Lichenologist*. 43 (1): 7–25. <https://doi.org/10.1017/S0024282910000617>
- Westberg M., Millanes A.M., Knudsen K., Wedin M. 2015. Phylogeny of the Acarosporaceae (Lecanoromycetes, Ascomycota, Fungi) and the evolution of carbonized ascomata. – *Fungal Divers*. 73: 145–158. <https://doi.org/10.1007/s13225-015-0325-x>
- White T.J., Bruns T., Lee S., Taylor J.W. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. – In: *PCR Protocols: a Guide to Methods and Applications*. New York. P. 315–322. <https://doi.org/10.1016/B978-0-12-372180-8.50042-1>
- Wijayawardene N.N., Hyde K.D., Al-Ani L.K.T., Tedersoo L., Haelewaters D., Rajeshkumar K.C., Zhao R.L., Aptroot A., Leontyev D.V., Saxena R.K., Tokarev Y.S., Dai D.Q., Letcher P.M., Stephenson S.L., Ertz D., Lumbsch H.T., Kukwa M., Issi I.V., Madrid H., Phillips A.J.L., Selbmann L., Pfliegler W.P., Horváth E., Bensch K., Kirk P.M., Kolaříková K., Raja H.A., Radek R., Papp V., Dima B., Ma J., Malosso E., Takamatsu S., Rambold G., Gannibal P.B., Triebel D., Gautam A.K., Avasthi S., Suetrong S., Timdal E., Fryar S.C., Delgado G., Réblová M., Doilom M., Dolatabadi S., Pawłowska J., Humber R.A., Kodsueb R., Sánchez-Castro I., Goto B.T., Silva D.K.A., de Souza F.A., Oehl F., da Silva G.A., Silva I.R., Błaszowski J., Jobim K., Maia L.C., Barbosa F.R., Fiuza P.O., Divakar P.K., Shenoy B.D., Castañeda-Ruiz R.F., Somrithipol S., Lateef A.A., Karunarathna S.C., Tibpromma S., Mortimer P.E., Wanasinghe D.N., Phookamsak R., Xu J., Wang Y., Tian F., Alvarado P., Li D.W., Kušan I., Matočec N., Maharachchikumbura S.S.N., Papizadeh M., Heredia G., Wartchow F., Bakhshi M., Boehm E., Youssef N., Hustad V.P., Lawrey J.D., Santiago A.L.C.M.A., Bezerra J.D.P., Souza-Motta C.M., Firmino A.L., Tian Q., Houbraken J., Hongshan S., Tanaka K., Dissanayake A.J., Mon-teiro J.S., Grossart H.P., Suija A., Weerakoon G., Etayo J., Tsurukau A., Vázquez V., Mungai P., Damm U., Li Q.R., Zhang H., Boonmee S., Lu Y.Z., Becerra A.G., Kendrick B., Brearley F.Q., Motiejūnaitė J., Sharma B., Khare R., Gaikwad S., Wijesundara D.S.A., Tang L.Z., He M.Q., Flakus A., Rodriguez-Flakus P., Zhur-benko M.P., McKenzie E.H.C., Stadler M., Bhat D.J., Liu J.K., Raza M., Jeewon R., Nasonova E.S., Prieto M., Jayalal R.G.U., Erdoğan M., Yurkov A., Schnittler M., Shchepin O.N., Novozhilov Y.K., Silva-Filho A.G.S., Liu P., Cavender J.C., Kang Y., Mohammad S., Zhang L.F., Xu R.F., Li Y.M., Dayarathne M.C., Ekanayaka A.H., Wen T.C., Deng C.Y., Pereira O.L., Navathe S., Hawksworth D.L., Fan X.L., Disa-nayake L.S., Kuhnert E., Grossart H.P., Thines M. 2020. Outline of Fungi and fungus-like taxa. – *Myco-sphere*. 11 (1): 1060–1456. <https://doi.org/10.5943/mycosphere/11/1/8>
- Yazıcı K., Aslan A., Aptroot A., Etayo J., Karahan D., Sipman H. 2020. Lichens and lichenicolous fungi from Bitlis province in Turkey. – *Lindbergia*. 1: linbg.01126. <https://doi.org/10.25227/linbg.01126>
- Yurchenko E.O. 2011. Lichens of Belarus: an illustrated electronic handbook. K.E. Dovgailo, Minsk, 1 CD.
- Zoller S., Scheidegger C., Sperisen C. 1999. PCR primers for the amplifications of mitochondrial small subunit ribosomal DNA of lichen-forming Ascomycetes. – *Lichenologist*. 31: 511–516. <https://doi.org/10.1006/lich.1999.0220>