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Post-print: Newly Recorded Species of Caloplaca and Xanthoria Lichens from China

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Abstract

Through the investigation of lichen specimens collected from Wuliang Mountain, Jingdong Yi Autonomous County, Yunnan Province, Caloplaca indica (three-septate spore type) and Ramboldia haematites were identified as new records to China in the genera Caloplaca and Ramboldia, respectively. During the curation of laboratory specimens, Ramboldia haematites was additionally documented from Fujian Province and Guangxi Province. This paper provides detailed descriptions of their morphological, anatomical, and chemical characteristics, along with photomicrographs. This study enriches the species diversity of lichens in Yunnan, Fujian, and Guangxi provinces, and provides fundamental data and reliable information for taxonomic research on the genera Caloplaca and Ramboldia. The voucher specimens are deposited in the Herbarium of Shandong Normal University (SDNU).

Full Text

Preamble

New Records of *Caloplaca* and *Ramboldia* from China

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Abstract

Examination of lichen specimens collected from Wuliang Mountain in Jingdong Yi Autonomous County, Yunnan, revealed two species new to China: *Caloplaca indica* and *Ramboldia haematites*. Subsequent investigation of herbarium material also identified *R. haematites* in Fujian and Guangxi provinces. This paper provides detailed descriptions of the morphological, anatomical, and chemical

characteristics of both species, accompanied by micrographs. These findings enhance our understanding of lichen diversity in Yunnan, Fujian, and Guangxi, and contribute fundamental data to the taxonomic study of the genera *Caloplaca* and *Ramboldia*. All specimens examined are deposited in the Herbarium of Shandong Normal University (SDNU).

Keywords: taxonomy, lichenized fungi, East Asia

Introduction

The Jingdong Yi Autonomous County is located in southwestern Yunnan Province and features a subtropical monsoon climate. Elevations range from 795 to 3,371 m above sea level, with an average annual relative humidity of 77% and average annual rainfall of 1,086.7 mm.

Caloplaca Th. Fr. s. lat. (Teloschistaceae, Teloschistales, Lecanoromycetes, Ascomycota) comprises species characterized by crustose or placodioid thalli. The genus includes approximately 350 species worldwide (Lücking, 2016). While species typically possess orange apothecia that turn K+ purple due to anthraquinones, the key diagnostic feature is the presence of polar-bilocular ascospores. In 1881, Müller established *Caloplaca* section Triophthalmidium for species with plurilocular ascospores (3–6 locules). This section is predominantly distributed in tropical and subtropical regions, occurring mainly on bark (corticolous) and rarely on rock (saxicolous) (Smith, 2009; Joshi et al., 2014).

The genus *Ramboldia* (Ramboldiaceae, Lecanorales, Lecanoromycetes, Ascomycota) was established by Kantvilas & Elix (1994). It is characterized by a crustose thallus, lecideoid apothecia, Lecanora-type asci, anastomosing paraphyses, and simple, persistently hyaline ascospores (Elix, 2004; Kantvilas et al., 1994, 2007). Some species exhibit orange to red pigmentation in their apothecia due to russulone and related anthraquinones (Kantvilas et al., 1994; Kalb et al., 2008). The genus comprises approximately 30 species worldwide (Lücking, 2016). In China, only four species have been reported: *R. cinnabarina*, *R. elabens*, *R. heterocarpa*, and *R. russula* (Zahlbruckner, 1930; Abdulla & Wu, 1998; Aptroot & Sparrius, 2003; Obermayer 2004).

The aim of our study is to expand knowledge of species composition within *Caloplaca* and *Ramboldia* in China, providing fundamental data for the forthcoming Lichen Flora of China. Here, we report *Caloplaca indica* and *Ramboldia haematites* as new records for China, with *R. haematites* additionally recorded for the first time from Fujian and Guangxi provinces.

1. Materials & Methods

All specimens examined are deposited in the Lichen Section of the Botanical Herbarium at Shandong Normal University (SDNU). Morphological and anatomical characters were studied using a stereo-microscope (Olympus SZ) and a polarizing microscope (Olympus CX21). Spot tests were performed on

the thallus and medulla using standard reagents: K (10% aqueous potassium hydroxide), C (saturated aqueous sodium hypochlorite), I (Lugol' s iodine), and Pd (saturated p-phenylenediamine in 95% ethanol). Lichen substances were identified by thin-layer chromatography (TLC) using solvent system C (Orange et al., 2010). Photomicrographs were captured using Olympus SZX16 and BX61 microscopes equipped with a DP72 camera.

2. Taxonomic Descriptions

***Caloplaca indica* Y. Joshi, Jagad. Ram & G.P. Sinha, in Joshi, Jagadeesh, Singh & Sinha, National Academy Science Letters 37(6): 517 (2014)**

[Figure 1: see original paper]

MORPHOLOGY. Thallus crustose, corticolous, whitish grey to greenish grey. Photobiont layer continuous. Prothallus ± present, forming a black line at borders. Apothecia zeorine, 0.25–1 mm diam.; disc brown, flat; proper margin thin, flush to raised above the level of disc, concolorous or slightly darker than disc; thalline margin thin, smooth to crenulate, concolorous with thallus. Epithecium yellowish brown, 25–32.5 m high, K–; hymenium colorless, 75–100 m high, oil droplets present; hypothecium colorless, oil droplets ± present. Asci clavate, 50–57.5 × 15–20 m, Teloschistes-type, 8-spored. Ascospores hyaline, bi- to trilocular, slightly constricted in the centre, all locules of ± equal size, 20–27.5 × 10–13 m. Pycnidia not seen. On bark.

Figure caption: A. Thallus and prothallus (black); B, C. Apothecium section; D. Amphithecium (no crystals); E. Ascospores (bilocular); F. Ascospores (trilocular). Scale bars: A = 2 mm; B = 50 µm; C = 10 µm; D = 10 µm.

CHEMISTRY. Thallus and medulla K–, C–, KC–, Pd–, UV+ yellowish orange. Apothecia K–, C–, KC–, Pd–. Lichexanthone detected by TLC.

DISTRIBUTION. The species is reported so far only from Eastern Himalaya (Joshi et al., 2014). New to China.

SPECIMENS EXAMINED. China. Yunnan: Jingdong, Wuliangshan, alt. 2 200–2 300 m, on bark, 7 Aug. 2017, R. Tang, M. J. Sun, S. K. Yan & J. M. Fu 20170874, 20170667 (SDNU).

COMMENTS. *Caloplaca indica* is mainly characterized by the greyish UV+ yellowish orange (lichexanthone present) thallus, zeorine apothecia, bi- to trilocular ascospores. In terms of ascospore morphology, the species resembles *Caloplaca crocea* (Kremp.) Hafellner & Poelt and *Caloplaca trilocularis* Zahlbr. *Caloplaca crocea* differs mainly in having yellow to yellowish orange apothecia. *Caloplaca triloculans* differs mainly in having crystals in amphithecium and a thick thalline margin (Joshi et al., 2014).

***Ramboldia haematites* (Fée) Kalb, Lumbsch & Elix, Nova Hedwigia 86 (1-2): 33 (2008)**

[Figure 2: see original paper]

MORPHOLOGY. Thallus grey or greyish-green, frequently continuous or smoothly rimose, 90–150 m thick. No vegetative propagules present. Prothallus not seen. Apothecia adnate, roughly round, flat, 0.15–1 mm diam; disc orange-red, pruina absent; exciple red, K+ purple; epithecium 10–14 m thick, reddish; hymenium 35–45 m thick, colourless; subhymenium 20–35 m thick, colorless; hypothecium 55–100 m thick, pale brown. Asci clavate, 37.5–45 × 10–15 m, Lecanora-type, 8-spored; Ascospores colourless, simple, ellipsoid, 8–10 × 3–4 m. Pycnidia not seen. On bark.

Figure caption: A. Thallus and apothecia; B. Apothecium section; C. Apothecium section (showing epihymenium and exciple K+ reaction); D. Simple ascospores. Scale bars: A = 1 mm; B = 50 m; C = 50 m; D = 10 m.

CHEMISTRY. Thallus and medulla K+ yellow to red or K-, C-, UV+ yellow. Lichexanthone, secalonic acid A (±), norstictic acid and russulone detected by TLC.

DISTRIBUTION. This species is known from North America, Africa, Australia, New Caledonia (Kalb et al. 2008; Elix 2009) and Japan (Yamamoto et al. 2013). New to China.

SPECIMENS EXAMINED. China. Yunnan: Jingdong, Wuliangshan, alt. 2 200 m, on bark, 7 Aug. 2017, R. Tang, M.J. Sun, S.K. Yan & J. M. Fu 20170679, 20170847 (SDNU). Guangxi: Baise, Cenwanglaoshan, alt. 1 800 m, on bark, 24 Feb. 2011, L. Li 20111740 (SDNU). Fujian: Longyan, Huanlianyu, alt. 1 400 m, on bark, 29 Oct. 2010, D. F. Jiang 20105509 (SDNU).

COMMENTS. *Ramboldia haematites* is morphologically similar to *Ramboldia russula* (Ach.) Kalb, Lumbsch & Elix, but differs by having norstictic acid (not fumarprotocetraric acid) in the apothecia (Kantvilas et al. 1994; Elix 2004; Kantvilas et al. 2007; Kalb et al. 2009; Gumboski 2014). Our specimens are very similar to the original description of *R. haematites* (Elix 2009), except that we failed to detected any connorstictic acid, which was considered one of the taxonomically important characteristics for the species by Kalb et al. (2008).

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