The genus *Calycularia* (Calyculariaceae, Marchantiophyta) in Thailand

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**ABSTRACT**

A taxonomic study of the genus *Calycularia* in Thailand is presented, based on herbarium specimens and field surveys. Only one species is recognized in the country, namely *Calycularia crispula*. A detailed description, line drawings and photographs are provided. In addition, *Apopella endiviifolia* (Pelliaceae) is excluded from the Thai bryoflora.

**KEYWORDS:** *Apopella endiviifolia*, bryophyte, *Calycularia crispula*, Calyculariaceae, Thailand, thalloid liverwort.

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**INTRODUCTION**

*Calycularia* Mitt. is a small genus of simple thalloid liverworts recently placed in the monotypic family Calyculariaceae (Crandal-Stotler *et al.*, 2008). The genus contains only two species: *Calycularia crispula* Mitt. and *C. laxa* Lindb. & Arnell (Konstantinova & Mamontov, 2010; Söderström *et al.*, 2016), widely distributed from North America and northern Russia to tropical East Africa and tropical Asia. *Calycularia* is easily separated from most simple thalloid liverworts by the presence of ventral scales (Konstantinova & Mamontov, 2010).

There are few published reports of *Calycularia* in Thailand, perhaps due to the scarcity of bryological surveys in the past (Sukkharak & Chantanaorrapint, 2014), but one of the two species, *C. crispula*, has been reported from Doi Inthanon and Doi Pha Hom Pok National Parks, Chiang Mai Province (Kitagawa, 1969; Lai *et al.*, 2008; Konstantinova & Mamontov, 2010). The purpose of this paper is to summarize the current knowledge of the genus *Calycularia* in Thailand and to provide a detailed description of *C. crispula*.

**MATERIAL AND METHODS**

This study was based on fresh specimens collected in northern Thailand as well as herbarium specimens housed in BCU, BKF, CMUB, MO and PSU. Morphological and anatomical details were studied using stereo, compound and electron microscopes and the distinctive characters of *Calycularia crispula* were illustrated with the aid of an Olympus drawing tube. All cited specimens have been seen by the authors.

**TAXONOMIC TREATMENT**


Thalli yellowish-green to dark green, margins strongly undulate or crispate, 5–10 cm long, 0.5–0.8 cm wide; branches lateral, irregular or furcate; apical

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portion of thallus emarginated or nearly obcordate; costa distinct, rather broad, 1–1.8 mm wide, more-or-less flat dorsally and convex ventrally, in transverse section up to 15–20 cells thick, gradually tapering into unistratose lamina, dorsal epidermal cells rectangular to rectangular-hexagonal, 30–80 × 25–50 μm, central strand lacking; unistratose lamina 40–50 cells wide. Ventral scales in 2 rows on costa, visible near the apical notch, hyaline, purplish or purplish-red, linear to lanceolate, 300–1500 × 80–250 μm, straight or recurved, 2–5(−6) cells wide at the base, gradually or abruptly tapering to a long uniseriate tip, with marginal cilia or slime papillae. Oil-bodies minute, of 2–5 granules, 20–50 per cell. Rhizoids yellowish, pale brown or colorless, numerous, restricted to ventral side of costa.

Dioicus. Antheridia dorsal, in several rows along costa, covered by perigonal scales, 1–4 sub-sessile, globose antheridia per scale; scales unistratose, pale green or colourless, erect, lamelliform, laciniate-dentate at the apex. Archegonia dorsal on costa, in dense clusters, surrounded by perichaetial scales; scales prostrate, colourless, lanceolate. Pseudoperianth colorless, campanulate to inflated-cylindrical, 3–4 cells thick at the base, unistratose at the apex; mouth with 3–4 laciniate lobes, with laciniae biserate (or multiseriate) almost to the apex. Capsule brownish to blackish, globose, 1–1.2 mm in diam., dehiscing by 4–7 irregular valves. Seta up to 3 cm long, 7–10 cells in diameter. Spores blackish to dark brown, sub-triangular to globose, 30–45 μm in diam., the wall tuberculate; tubercules cylindric, 4–7 μm long, truncate at the apex. Elaters brown, unbranched, 250–350 μm long, with 2–3-helicoidal bands.

Thailand.— Northern: Chiang Mai [Doi Pha Hom Pok National Park, ca 2,000 m alt., 2 Nov. 2015, Chantanaorrapint 2949 (PSU); Doin Inthanon National Park, 19 Dec. 1965, Touw 9882 (MO, [MO-2201196]); Ang-ka, ca 2,500 m alt., 31 Dec. 1972, Patanapolpaiyan s.n. (BCU); 14 Dec. 1978, Thaithong 902, 919 (BCU); 30 Nov. 2007, Nati 975 (BCU); 29 June 2008, Nati 1346 (BCU); 15 July 2012, Chantanaorrapint & Promma 1418 (BKF, PSU); 31 Oct. 2015, Chantanaorrapint 2867, 2874 (BKF, PSU); Kew Mae Pan natural trail, ca 2,300 m alt., 1 Nov. 2015, Chantanaorrapint 2829 (BKF, PSU); Doin Chiang Dao Wildlife Sanctuary, Huai Tat, ca 1,000 m alt., 11 Dec. 1978, Thaithong 463 (BCU); Pang Eikai, 1,200 m alt., 11 Dec. 1978, Thaithong 716 (BCU); Doin Suthep-Pui National Park, Doi Mon Long Mt, ca 1,340 m alt., 4 Aug. 2005, Monlong 59 (CMUB); Doi Pui Mt, ca 1,600 m alt., 16 Nov. 2010, Printarakul 5010 (CMUB)]; Phitsanulok [Phu Hin Longkla National Park, Lan Hin Pum, ca 1,300 m alt., 28 May 2018, Chantanaorrapint & Suwanmala 2653 (BKF, PSU)].

Distribution.— Widespread, but scattered, from East Africa to Asia and the Indian subcontinent, including Ethiopia, Malawi, Tanzania, Zambia, Bhutan, China, India, Myanmar, Nepal, Taiwan, and Thailand (Kitagawa, 1969; Lai et al., 2008; Konstantinova & Mamontov, 2010; Daniels et al., 2014; Manju et al., 2015). Also reported from Costa Rica (Dauphin, 2005) and Mexico (Grolle, 1980) but these reports are based on single collections and are likely dubious (B. Crandall-Stotler, pers. comm).

Ecology.— In Thailand, Calycularia crispula grows on the bases of tree trunks, decaying wood and humus rich rocks in humid montane forests at 1,200–2,550 m. It is usually associated with other liverwort species of the genera Bazzania Gray and Plagiochila (Dumort.) Dumort.

Notes.— Calycularia crispula is characterized by 1) strongly undulate or cribrate thallus margins forming lobe-like structures, 2) costa clearly distinct from the unistratose wings, 3) mouth of pseudoperianth laciniate with lacinia biseriate to multiseriate almost to the apex, and 4) spores that are densely tuberculate with the tubercles cylindrical and apically truncate. In contrast, Calycularia laxa differs from C. crispula by its pseudoperianth mouth being ciliate, with cilia uniseriate almost from the base and spore ornamentation being echinate or spinose.

In their general appearance, Calycularia is similar to Pellia Raddi but Calycularia has ventral scales along the costa whereas Pellia does not. Calycularia may also be confused with Pallavicinia Gray, which also possesses a distinct costa, unistratose thallus wings and gametangia along the costa. However, Pallavicinia differs from Calycularia in having ventral hairs rather than scales, and having a central strand in the costa.

Lai et al. (2008) reported Appellia endiviifolia (Dicks.) Nebel & D.Quandt (as Pellia endiviifolia (Dicks.) Dumort.) for Thailand based on Monlong 59 (CMUB) from Doi Suthep-Pui National Park, Chiang Mai province. Re-examination of this specimen has revealed it to be Calycularia crispula and, consequently, Appellia endiviifolia must be excluded for the Thai bryoflora.

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