*nervosa* to inhibit proliferation of MCF-7 cell line suggests the presence of compounds with antiproliferative property. $\alpha$-Tocopherol (20.48%), a well-known antioxidant in MLE of *G. nervosa*, is already considered as an anticancer compound. Further, the antioxidative activity observed in the extracts of *Rheum officinale* Baill., *Sanguisorba officinalis* Linn. and *Paris polyphylla* Smith have been correlated with cytotoxicity against MCF-7 and AS49, adenoma carcinoma cell lines[9]. Furthermore, phytol (14.25%) detected in MLE has already been substantiated to demonstrate antiproliferative effect on hepatocellular cancer cell lines such as Huh-7 and HepG2. In addition, $\gamma$-sitosterol (4.48%) detected in MLE of *G. nervosa* has also been validated with antiproliferative activity against MCF-7 and lung carcinoma cell line A 549 (ref. 10). Thus, the concomitant presence of these three phytochemicals in MLE can be correlated to the antiproliferative activity observed against MCF-7 cell line. Additionally, the presence of $\alpha$-linolenic acid (8.20%), an essential $\omega$-3 fatty acid present in MLE is significant and has been associated with neuroprotective properties[11]. Similarly, *n*-hexadecanoic acid detected in MLE of *G. nervosa* is confirmed as a potent inhibitor of phospholipase A2 and would function as an anti-inflammatory agent[12].

Chronic inflammation has been commonly linked to the development of cancer. Furthermore, during the illness, patients suffer from neurological problems. Additional studies are being undertaken to evaluate the neuroprotective and anti-inflammatory properties of MLE. Thus the anti-inflammatory, neuroprotective and antiproliferative properties of MLE would make *G. nervosa* a prospective candidate for complementary therapy in cancer treatment.


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Received 10 September 2016; revised accepted 23 June 2017


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# Distribution and conservation status of *Anthoceros macrosporus* Steph. (Anthocerotophyta) – an endemic and threatened hornwort of India

*Anthoceros macrosporus* Steph., an endemic and threatened hornwort which was known from its type specimen only from Borghat, Maharashtra, India has recently been re-discovered from Maharashtra and Gujarat from a second location in restricted pockets. Hence, it is proposed to designate the taxon as endangered and to be included in the Red List of Plants by the IUCN. Morphotaxonomic details of the recently collected plants have been studied.

The important hornwort family Anthocerotaceae is represented in India by two genera, viz. *Anthoceros* (Micheli) L. emend. Prosk. and *Folioceros* Bharadwaj. Nine valid species of the genus *Anthoceros* have been recognized from India[1]. *Anthoceros macrosporus* Steph. is a rarely occurring endemic species of India. It was instituted by Stephani[2] based on the specimens collected from Bor Ghat/Bhor Ghat, Khandala, Maharashtra in the Western Ghats in 1893. Later on it was also reported from Kodaikanal in Tamil Nadu[3], and Trimbakeshwar, Palghar and Matheran in Maharashtra[4], though the species could never be collected again from its type locality. Hence it is considered as extremely rare species[5] restricted to the Western Ghats, a prominent hotspot of the Indian subcontinent. The species has been rediscovered from the Kasara Ghat, Maharashtra and Saputara and Amba forest localities, Gujarat of the Western Ghats (Figure 1), in 2009 and 2011 respectively. The rediscovery of this taxon from a new locality in the vicinity of its original record is interesting and informative as the present finding facilitated the study of this species for the first time on fresh materials. The rarity of this taxon could also be explained from the fact that the workers who have revised the hornworts of India in the past decades could not get fresh samples of the species to describe *A. macrosporus*. They could


**Figure 1.** Distribution of *Anthoceros macrosporus* St. in India.

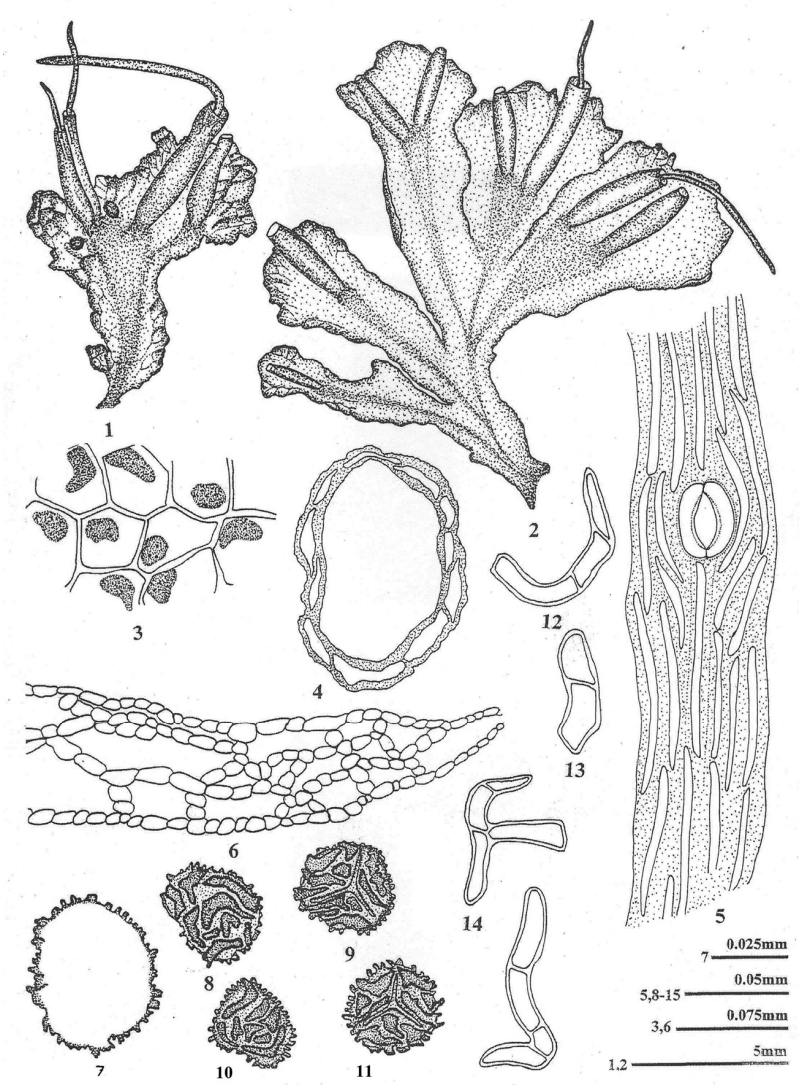


**Figure 2.** *Anthoceros macrosporus* St. 1, 2, Thalli with sporophytes. 3, Epidermal layer of thallus showing chloroplasts. 4, Cross-section of involucre. 5, Epidermal layer of capsule wall showing stoma. 6, Cross-section of thallus showing mucilage chambers. 7, Equatorial view of spore. 8, 10, Distal face of spores. 9, 11, Proximal face of spores with tri-radiate mark.

only provide a description and data of this species based on the type specimens[1].

*Anthoceros macrosporus* Steph., Sp. Hepat. 5: 1005 (1916).

Type: India orientales, prope vicum, Khandala in montibus Borghat 'Bhor Ghat' (alt. ca. 600 m), 16584, Oct. 19, 1893 (G).

Plants autoicous (?), androecia not found, female thalli spongy, fan-shaped, expansive with narrower base, lobed, up to 20 mm long, 5–8 mm wide at apex; nostoc auricles frequently present; mucilage chambers in 2–3 layers, epidermal layer with single chloroplast in each cell, chloroplast irregular, pyrenoid bodies scattered all over; rhizoids confined to mid-dorsal line on ventral surface of thallus; cells of the upper epidermal layer ± 38 × 15.2 µm, cells of lower epidermal layer ± 22.8 × 11.4 µm in cross-section. Involucre spongy, 3–5 mm long, with smooth mouth as wide as involucre or narrower sometimes; mucilage chambers arranged in single layer in cross-section. Mature capsules usually 25 mm or more long; capsule wall 3–4 cells thick in a cross-section. Epidermal layer of capsule wall stomatiferous, stomatal frequency 4–5 stomata/sq. mm, stomata 50–60 × 25–30 µm in size; each stoma with two reniform guard cells, surrounded by 5–6 longer than broad cells with highly thickened radial and end walls with a narrow cell lumen; inner lining layer of capsule ca 19 µm composed of quadrate cells. Columella ca 15.2 µm thick in a cross-section. Spores dark brown–black, 45.6–57 µm in diameter; sporoderm with thick and dense ridges with spinulate–baculate and dentate apices, densely placed on distal and proximal faces, tri-radiate mark on proximal face distinct, terminating shortly before periphery. Pseudoelaters brown, thin-walled, 49.3–83.6 µm long, 4–5 celled, sometimes branched (Figure 2).

Specimens examined: India: Maharashtra, Thane, Kasara Ghat (19°40′N, 73°29′E), alt. ca 585 m, 22.09.2011, on soil, leg. V. K. Hile, 2, 7, 9, 15 (VKH p.c.); Nashik, Kasara Ghat, 22.09.2011, on soil, leg. V. K. Hile, 3 (VKH p.c.). (Specimens deposited at Herbarium, CSIR-National Botanical Research Institute (NBRI), Lucknow (LWG).

*Habitat and ecology:* Plants were found growing on soil in association with *Bryum capillare* Hedw. at an altitude of ca. 585 m.

A critical and comparative study of recently collected specimens (available at CSIR-NBRI Herbarium (LWG)) with type specimens and description revealed that thalli are less wide at apex in our specimens compared to type specimens, i.e. 6–11(13) mm wide at apex and smaller size of pseudoelaters compared to type specimens (139–190 µm long), which may be due to changes in climatic and ecological conditions over a long period of time. *A. macrosporus* resembles *A. punctatus* L., *A. pandei* Udar & A. K. Asthana and *A. crectus* Kashyap in some features, especially the morphoform of thalli, but can be clearly recognized by its characteristic sporoderm architecture. In *A. punctatus* sporoderm is reticulate, rather pitted; *A. pandei* is clearly distinctive in having smaller spores (39–45 µm) with verrucate to lamellate sculpturing, while *A. erectus* can be distinguished by reticulate sporoderm pattern with spinulate ridges enclosing irregularly shaped lumeni.

Of the seven locations (five in Maharashtra and one each in Tamil Nadu and Gujarat) where *A. macrosporus* has been located in the country so far, the species could never be collected again from its type locality at Borghat in Maharashtra and Kodaikanal in Tamil Nadu. As such, the species is presently known from severely fragmented populations at only five inferred sites spread across Maharashtra and Gujarat with an 'extent of occurrence' of much less than 5000 km$^2$ and a highly restricted 'area of occupancy'. Therefore, as per the IUCN Red List categories and criteria version 3.1 (ref. 6), *A. macrosporus* belongs to endangered category [ENB1a + 2a; C2a(i)] at global level.

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ACKNOWLEDGEMENTS. We thank the Director, CSIR-NBRI, Lucknow for encouragement and providing the necessary facilities. R.G. thanks DST (SERB) for providing funds under postdoctoral scheme (YSS). Work has been carried out under OLP-0083.

Received 26 May 2017; revised accepted 19 September 2017

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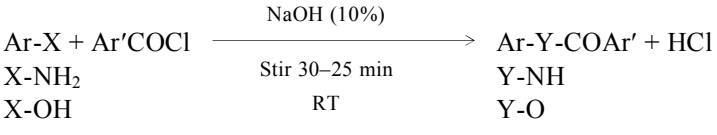
# Sodium bicarbonate aqueous matrix as novel industrial solvent for benzoylation of some Ar-OH, Ar-NH and R-HN functionalities

It is a well accepted fact that chemical transformations can occur in solid, liquid and gaseous matrix; however, liquid matrix (solvent) dominates due to certain distinct multi-dimensional advantages especially at molecular level, making it a versatile tool for industrial manufacturing processes[1–4]. It has been estimated that 28-million metric tonnes (MMT) of organic solvents are commercialized globally for different industrial purposes, majority of which get utilized in chemical and pharmaceutical manufacturing[5]. Recently, global regulatory pressure regarding toxicity of organic solvents on the living population[6] and their not ecofriendly characteristic[7], have raised significant concern worldwide to search for an alternatively less hazardous industrial solvent/s benign not only for the living population, but also ecologically compatible, chemically recyclable, and within the guideline of regulating authorities. 'Solvent substitution', is a newer philosophy currently adopted by most of the chemical manufacturing industries where manufacturing processes have now been shifted from conventional to less hazardous solvents without compromising on the final product both in terms of quality as well as quantity. Evaluation and in-process acceptance of newer solvent/s for classical manufacturing process is based on a thorough multi-dimensional assessment of the same by centralizing three main aspects: worker safety, process safety, and regulatory and environmental safety[8,9].

Benzoylation[10], a common substitution reaction involves introduction of ArCO-functionality (Scheme 1) into an organic compound. The technique is considered to be an economic, efficient, and feasible methodology for protecting and identifying aliphatic as well as aromatic organic




**Scheme 1.** Generalized depiction of benzoylation in NaOH to yield amide/ester derivatives.