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Review

Phytochemical and biological studies of bryophytes

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This paper is dedicated to the memory of Professor Meinhart H. Zenk

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ABSTRACT

The bryophytes contain the Marchantiophyta (liverworts), Bryophyta (mosses) and Anthocerotophyta (hornworts). Of these, the Marchantiophyta have a cellular oil body which produce a number of mono-, sesqui- and di-terpenoids, aromatic compounds like bibenzyl, bis-bibenzyls and acetogenins. Most sesqui- and di-terpenoids obtained from liverworts are enantiomers of those found in higher plants. Many of these compounds display a characteristic odor, and can have interesting biological activities. These include: allergenic contact dermatitis, antimicrobial, antifungal and antiviral, cytotoxic, insecticidal, insect antifeedant, superoxide anion radical release, 5-lipoxygenase, calmodulin, hyaluronidase, cyclooxygenase, DNA polymerase β , and α -glucosidase and NO production inhibitory, antioxidant, piscicidal, neurotrophic and muscle relaxing activities among others. Each liverwort biosynthesizes unique components, which are valuable for their chemotaxonomic classification. Typical chemical structures and biological activity of the selected liverwort constituents as well as the hemi- and total synthesis of some biologically active compounds are summarized.

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1. Introduction

The bryophytes are found everywhere in the world except in the sea. They grow on trees, on soil, lakes, rivers even in Antarctica. The bryophytes are placed taxonomically between algae and pteridophytes and there are about 24,000 species in the world. They are further divided into three phyla, Bryophyta (mosses

14,000 species, Fig. 1), Marchantiophyta (liverworts 6000 species, Fig. 2) and Anthocerotophyta (hornworts 300 species, Fig. 3). They are considered to be the oldest terrestrial plants, although no strong scientific evidence for this has appeared in the literature. This hypothesis was mainly based on the resemblance of the present-day liverworts to the first land plant fossils, the spores of which date back almost 500 million years. Among the bryophytes, almost all liverworts possess beautiful cellular oil



Fig. 1. Moss species.



Fig. 3. Hornwort, *Phaeoceros carolinianus*.



Fig. 2. Liverwort, *Pellia endiviifolia*.



Fig. 4. Oil bodies of the liverworts *Frullania vethii*.

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