

Antimicrobial compounds in bryophytes

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Bryophytes are a group of plants divided into three phyla: mosses (Bryophyta), liverworts (Marchantiophyta), and hornworts (Anthocerotophyta). Through ages, especially in Asia and North America, bryophytes were used as medicines. Antibiotic activity possess the following substances appearing in the bryophytes: bibenzyls, terpenoids, benzenoids, fatty acid derivatives, and polyphenols [1,2].

Bibenzyls isolated from liverworts, including some marchantins and riccardins showed antibacterial activity against *Staphylococcus aureus* [3] and antifungal activity against *Candida albicans* [4]. Marchantin A obtained from many *Marchantia* species acted against bacteria *Bacillus* sp., *Enterobacter cloacae*, *Escherichia coli*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *S. aureus*, and fungi *Aspergillus* sp., *C. albicans*, *Cryptococcus neoformans*, *Sporothrix schenckii*, and *Trichophyton* sp. [5]. Sesquiterpenoids from liverworts (some herbertenols, herbertenes, mastigophorenes) possessed different activity against *S. aureus*, *Bacillus subtilis*, and *Klebsiella pneumoniae* [6,7]. The antimicrobial activity also showed isolated mainly from liverworts terpenoids, such as α -pinene, β -pinene, camphor, sabiene, myrcene, α -terpinene, and limonene [8].

Polyphenolic compounds presented in mosses *Atrichum*, *Dicranum*, *Mnium*, *Polytrichum*, and *Sphagnum* spp. were considered to be antibiotically active substances [9]. Antimicrobial activity had isolated flavonoids: apigenin and vitexin from *Plagiomnium affine*, saponarine from *P. cuspidatum*, bartramiaflavone from *Bartramia pomiformis*, lucenin-2 from *Hedwigia ciliata*, apigenin-7-O-triglycoside and luteolin-7-O-neohesperidoside from *Dicranum scoparium* [10,11]. *Hypnum cupressiforme* contains several hypnogenols, biflavanoids, and dihydroflavanols, which acted antibacterial [12,13].

Additionally, activity against *Enterococcus faecalis*, *S. aureus*, *Streptococcus pyogenes*, *E. coli* and *K. pneumoniae*, was confirmed for extracts of *Bryum argenteum*, *Dicranum scoparium*, *Dryptodon pulvinatus*, *Orthotrichum anomalum*, *Plagiomnium undulatum*, and *Schistidium crassipilum*. Whereas, *Polytrichum juniperinum* and *P. piliferum* acted only against Gram-positive strains [14].

References

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Bryophytes

Extracts

Compounds



Antimicrobial activity