International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 31-12-2020, Accepted: 15-01-2021, Published: 31-01-2021
Volume 6, Issue 1, 2021, Page No. 667-669

Bryophytes: A potent source of phytotherapeutic remedies- A critical review

G S Deora
Department of Botany, University College of Science, Mohanlal Sukhadia University Udaipur, Rajasthan, India

Abstract
Bryophytes are the second largest group of terrestrial land plants and represented by three divisions namely Marchantiophyta (liverworts), Anthocerophyta (hornworts) and Bryophyta (mosses). These plants are free from any kind of microbial attack till date due the presence of self-defending specific proteins and biologically active secondary metabolites such as polysaccharides, terpenoids, flavonoids, amino acids, lipids, steroids etc. These compounds have antimicrobial, hepatic disorders, insecticidal, antioxidant, antiviral, cytotoxic, antiseptic, and antileukamic activities. The aim of the present review was to gather all the informations about the therapeutic uses of bryophytes. Further the plants of this group is a potent source of therapeutic ramedies and chemical products are used in the different field of life sciences, pharmacology and other disciplines of pharmaceutical sciences.

Keywords: bryophytes, phytoconstituents, phytotherapeutics, antimicrobial, cytotoxic

Introduction
Bryophytes include liverworts (Hepaticopsida) hornworts (Anthocerotopsida) and mosses (Bryopsida) having about 6000, 200 and 8000 species respectively [1]. This group of plants is the second largest group of land plants after angiosperms [2]. Bryophytes are less known plants in general due to small size, less and session availability, less biomass and problems in identification therefore these plants are neglected for the wide use [3].
Bryophytes are used as bioindicators of pollution, radioactivity and aquatic and heavy metals. These are also used for seed beds, medicines, food sources, pesticides, nitrogen fixation, moss gardening treatment of waste, construction furnishing, packing genetic engineering and soil conditioning [6, 7].
The phytochemistry of bryophytes revealed the presence of greater range of biologically active components such as carbohydrates, proteins, lipids, steroids, phenols, terpenoids, flavonoids, organic acids, fatty acids, aliphatic compounds, acetogenins plenylquinones aromatic and phenolic substances [8, 9].

Materials and Methods
The present review is a comprehensive work about the complete information of bryophytes as a potent source of phytotherapeutic remedies, medicinal and biological properties of their active phytochemicals. The informations were collected from different scientific sources and compiled at one place to provide the complete information about phytochemicals and their therapeutic properties of bryophytes for researchers and young scientists and pharmacologists for further use.

Medicinal potential of bryophytes
Ethnomedicinal potential
The concept of Paracelsus "doctrine of signature" was an ancient method to determine the medicinal properties of plant. This concept says that the resemblance of plant body parts to shape and structure of human and animal body organ for which it is used to treat. According to this concept or philosophy *Marchantia polymorpha* (liverwort) was used to cure hepatic disorder [10] as the shape of the thallus is resemble to the heart. Moss *Polytrichum commune* bears hairy calyptras and commonly known as hair cup moss, the oil of this moss was used by the women of ancient time on their hair [8]. Different ethnic groups of the different parts of the world used bryophytes to treat various types of diseases in their routine life. The *Plagiochasma appendiculatum* is used for the treatment of skin diseases by the Gaddi tribe of Himachal Pradesh, India [11]. Irular tribe of Attappady valleys of Kerala state used *Targionia hypophylla* cure skin diseases due to the resemblance of thallus of this plant to rough surface of the diseased part of the body. Tribal people of the South India used *Frullania ericoides* for the treatment of their hair related problems due to long- stemmed and hair like thallus [12].

The ethnomedicinal activity of bryophytes are summarized in table 1.

Table 1: Ethnomedicinal activity of bryophytes

S. No.	Botanical name	Family	Uses	References
1	*Conocephalum conicum* (Linn) Underw.	Conoce phalaceae	Antimicrobial, antifungal, antipyretic, antidotal; ued to treat cuts, swollen burns, fracture snake bites and gall stones.	13, 14
2	*Dummortiera hirsute* (Sw.) Nees.	Marchantiaceae	Source of antibiotics	16
3	*Frullania tamarisci* (Linn) Dumort	Jubulaceae	Antiseptic	7
4	*Herbertus* Gray sp.	Herbertaceae	Antiseptic, Antidiarrheal, Expectorants, Asringens	13,14
5	*Marchantia convolute* Gao et K C.	Marchantiaceae	Used for treatment of hepatitis, fever and gastric intolerance	18

	Zhang			
6	*Marchantia polymorpha* Linn.	Marchantiaceae	Paste of thallus is applied externally on inflammation and used as diuretic, for lever ailment, insect bites, to cure cuts.	14,15, 17
7	*Marchantia paleacea* Bertol.	Marchantiaceae	Antipyretic, used in skin tumefaction and hepatitis.	20
8	*Pallavicinia* Gray sp.	Pallaviciniaceae	Antimicrobial	15
9	*Plagiochila* (Dum.) Dum. sp.	Plagiochilaceae	Antileukamic, antimicrobial, and used as perfumes.	14
10	*Plagiochasma appendiculatum* Lehm. & Lindenb.	Aytoniaceae	Paste of fresh thallus is externally applied on affected part for the treatment of skin diseases.	13,15
11	*Riccardia* Gray sp.	Aneuraceae	Antileukamic	13,14
12	*Semibarbula orientalis* (Web.) Wijk & Marg	Pottiaceae	Antioxidant, antiinflamatory, antiulcer, anticancer, antibacterial	21
13	*Polytrichum cumine*	Polytrichaceae	Treat to cure fever, hemostate, injury to pneumonia, uterine prolapse and lymphocytic leukemia.	22
14	*Polytrichum juniperum*	Polytrichaceae	Antibacterial	23
15	*Polytrichum ohioense*	Polytrichaceae	Cytotoxic, anticancer	24

Large numbers of biologically acive natural compounds have been isolated from the bryophytes which act as an import source for the treatment of various types ailments. Marchantin A from M. polymorpha and M. tosana; riccardin from Riccardia multifida and perrotin E from Radula perrottetii show cytotoxicity against leukemic KB cells [25]. The biologically active constituent diplophyllin and ent-eudesmanolide isolated from Diplophyllium oblicans and D. taxifolium showed significant anticancer activity against human epidermoid carcinoma [26]. The sesquiterpenoids costunolide and tulipenalide have been isolated from Frullania monocera, Marchantia polymorpha, Porella japonicum, Wiesnerella denulata, Conocephalum supradecomositum and Plagiochlla semidecurrens showed anticacerious activity against human carcinoma of nasophynx. The compound isolated from Plagiochilla fusciculatae inhibited P_{388} cells [27].

Ecofriendly activity of bryophytes

The continuous and unmanaged use of synthetic chemicals as fungicides, insecticides, pesticides rodenticides by the farmers causing adverse effect on the environment and human health. In addition to this the constant use of concentrated form of these chemicals leads to increased resistance in the insects [28, 29]. Therefore, there is an urgent need to find out and use of new plant based natural products which should be ecofriendly and having no toxic effect as a alternatives to the toxic and hazardous synthetic chemicals. In this regards, bryophytes played an important role in last few decades. Fatty acids isolated from *Hypnum cupressiforme, Dicranum scoparium, Polytrichum formosum, Hamalothecium, lutescens* (mosses), *Conocephalum conicum* (liverworts), are used as herbal insecticides against *Sitophilus granaries*. Similarly the extract of moss powder of Calymperes afzelii, Thuidium gratum, Bryum coronatum and Barbula lambarenensis are used against maize stem bores disease [30, 31]. Bryum, Hypnum Fissidens and several other mosses grow in shallow water of lakes, ponds, steams in association with other thallophytes contain huge amount of lime and act as rock builders. The insoluble calcium carbonate precipitates along with mosses and their symbionts play an important role in soil conservation. In the developed countries like Ireland, Poland, West Germany and Sweden some liverworts and mosses are the important sources of fuel for generating natural gas, hydrogen, ethylene methanol etc. *Sphagnum* a peat moss are the best known source of peat coal for generation of heat and methane due to low sulphur, greater and rapid heat generating value. Some bryophytes such as liverworts and mosses are good indicators of environmental fluctuations, growth regulators and stuffing materials [20].

References

1. Hallingback T, Hodgetts N. Msses, Livrworts, Hornworts. Status Survey and Conservation Action Plan for Bryophytes. World Conservation Union, 2000, 53.
2. Mrko S, Anita B, Dragoljub G. Bryophytes as a potential source of medicinal compounds. Pregl Rev,2000:21:17-29.
3. Dndotiya D, Govindapyri H, Suman S, Uniyal PL. Check list of the bryophytes of India. Arch. Bryol,2011:88:1-26.
4. Saxena DK, Harinder. Uses of bryophytes. Resonance,2004:9:56-65.
5. Glime JM. Economic and Ethnic uses of bryophytes. America Editorial Committee. FI North America,2007:27:14-41.
6. Ashakawa Y. Biologically active compounds from bryophytes. Pure Appl. Chem,2007:79:557-580.
7. Ucuncu O, Cansu TB, Ozdemir T, Alpaykaraoglu S, Yayli N. Chemical compounds and antimicrobial activity of the essential oils of mosses (Tortula muralis Hedw., Homalothecium lutescens, (Hedw.) H. Rob., Hypnum cupressiforme Hedw and Pohlia nutans (Hedw.) Lindn. From Turkey. Turk J Chem,2010:34:825-834.
8. Pant G, Tiwari SD. Bryophytes and mankind. Ethnobotany,1990:2:97-103.
9. Asakawa Y. Pharmacologically active substances from oriental bryophytes and inedible mushrooms and Fijian kava. World Conference on Medicinal and Aromatic Plants Book of Abstract, 2001, 86.
10. Miller NG, Miller H. Make ye the bryophytes. Horticulture,1979:57:40-47.
11. Kumar K, Singh KK, Asthana AK, Nath V. Ethnotherapeutics of bryophyte Plagiochasma appendiculatum among the Gaddi tribes of Kangra valley, Himachal Pradesh, India. Pharm Biol,2000:38:353-356.
12. Ramesh M, Manju CN, Ethnobotanical note from Western Ghats, India. Bryol,2009:112:532-537.
13. Alam A, Some Indian bryophytes known for their biologically active compounds. Int Jappl Bio Pharm Tech,2012:3:239-246.
14. Azuelo AG, Sariana IG, Pabualan MP. Some medicinal bryophytes: their ethnobotanical uses and morphology. Asian Biodrv,2011:2:50-80.

15. Shirsat RP. Ethnobotanical uses of some common bryophytes and pteridophytes used by tribals of Melghat region (Ms) India. Ethnobot Leaf,2008:1:92.
16. Ding H. Medicinal spore plants of China. Shanghai Science and Technology Press: Shanghai, 1982.
17. Hu R. Bryology. Higher Education Press, Beijing, China, 1987, 465.
18. Rao M, Microbes and non-flowering plants: Impact and Applications. Ane Book Pvt. New Delhi, 2007, 213-214.
19. Tag H, Das AK, Loyi H. Anti-inflamatory plants used by Khamti tribe of Lohit distric in eastern Arunachal Pradesh, India. Nat Prod Radiance,2007:6: 334-340.
20. Sabovljevic A, Sokovik M, Glamoclija J. Bio-activities of extracts from some exenically farmed and naturally grown bryophytes. L Med Plants Res,2011:5:565-571.
21. Deora Vinod, Deora GS. Semibarbula orientalis (Web) Wijk and Marg: Apotential source of bioactive and high value phytochemicals,2021:33(31B):34-43.
22. Zhonghua Bencao,State administration of traditional Chinese medicine of the people's republic of China. Shanghai Science Technology Press, 1999, 22-23.
23. Cheng Z, Xiao Y, Wang X. Anti- tumor and pro-apoptotic activity of ethanolic extracts and its various fractions from *Polytrichum commune* Linn. ex Hedw. In L1210 cells. J Ethnopharmacol,2012:143:49-56.
24. Zhang GQ, Chang CJ, Stout TJ, Clardy J, Ho DK Cassady JM. Ohioensins: novel benzonaphthoxanthinones from *Polytrichum ohioense*.J Org Che,1993:58:366-372.
25. Ashakawa Y. Chemical constituents of bryophytes. In: Herz. W Girishebe H, Kirby, GW, editors Vol.42Springer Viena, 1982, 1-285.
26. Ohta Y, Anderson NH. Liu CB, Sesquiterpene constituents of two liverworts of genus *Diplophyllum* novel eudesmanolides and cytotoxicity studies for enantiometric methylene lactones. Tetrahedron,1977:33:617-628.
27. Ahsakawa Y. Bilogically active substances obtained from bryophytes. J Hatori Bot Lab,1981:50:123-142.
28. Aliokhin A, Baker M, Mota-Sanchez D, Dively G, Grafius E. Colorado potato beetle resistance to insecticides. Am J Pot Res,2008:85:395-413.
29. Walon ME, Mota-Sanchez D, Hallingworth RM, The MSU Arthropod Pesticide Resistance Database.
30. Abay G, Altum M, Karakoc OC, Gul F, Demirtas I. Insecticidal activity of fatty acid-rich Turkish bryophytes extracts against Sitophilusgranarious (Coleoptera: Curculionidae) Com Chem High T Scr,2013:16:806-816.
31. Ande AT, Wahedi JA, Fatoba PO. Biocidal activities of some tropical moss extract against maize stem bores. Ethnobot Leafl,2010:14:479-490.