

**PRELIMINARY STUDIES ON
THE LIVERWORT FLORA OF ST. TERESA'S COLLEGE
ERNAKULAM**

Dissertation submitted in partial fulfilment of the
requirements for the award of the Degree of Bachelor of
Science in
BOTANY

By

NAME: ASHNA SHAJI


Reg No: AB20BOT012




**DEPARTMENT OF BOTANY AND CENTRE FOR RESEARCH
ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM
APRIL 2023**


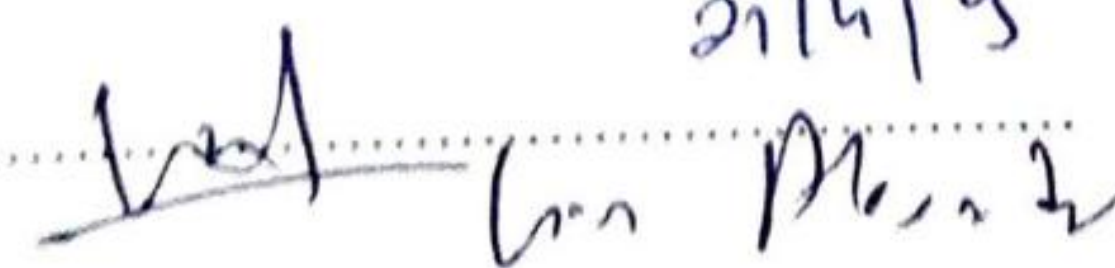
CERTIFICATE

This is to certify that the dissertation entitled "Preliminary studies on the Liverwort flora of St. Teresa's College Campus, Ernakulam" is an authentic record of research work carried out by Ms. ASHINA SHAJI (Reg. No. AB20BOT012) under the supervision and guidance of Dr. Chandini V. K., Department of Botany and Centre for Research, St. Teresa's College (Autonomous), Ernakulam in partial fulfilment of the award of the degree of Bachelor of Science (B.Sc.) in Botany. I further certify that no part of this work embodied in this project has been submitted for the award of any degree or diploma.


Dr. Liza Jacob
Head
Department of Botany & Centre for Research,
St. Teresa's College (Autonomous),
Ernakulam


Dr. Chandini V. K.
Supervising Teacher
Department of Botany & Centre for Research,
St. Teresa's College (Autonomous),
Ernakulam

Examiners:

- 1) 
Dr. Krishnamoorthy N.
21/4/23
- 2) 
Dr. M. S. S.



ACKNOWLEDGEMENT

I thank almighty God for the blessings bestowed upon me, that have helped me to complete the project successfully and also for giving me the courage, patience and wisdom to complete the work to the best of my quality.

It is my privilege to express my deep sense of gratitude, respect and admiration to Dr. Chandini V. K., Department of Botany St. Teresa's College (Autonomous), Ernakulam for suggesting this topic and for her valuable guidance and inspiration throughout the period of this work.

I wish to express here my grateful thanks to Dr. Liza Jacob, Head of the Department of Botany, St. Teresa's College (Autonomous), Ernakulam for providing all necessary facilities for the work.

I also take this opportunity to sincerely thank all the teaching and non-teaching staff of the Botany Department of St. Teresa's College (Autonomous), Ernakulam for their constant help and support that enabled me to complete this work successfully.

I record my sincere thanks to Dr. Manju C. Nair (Associate professor, Bryology division, University of Calicut) for her support in helping on identification of difficult taxa.

I express my love and heartfelt gratitude towards my parents and beloved ones for their constant encouragement and prayers.

I extend my sincere thanks to all my friends for their help, cooperation and encouragement to complete this project successfully.

ASHNA SHAJI

DECLARATION

I hereby declare that the project entitled “**Preliminary studies on the Liverwort flora of St. Teresa’s College Campus, Ernakulam**” submitted to Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirement for the Degree of Bachelor of Science in Botany is an original project done by me under the supervision and guidance of Dr. Chandini V.K., Department of Botany and Centre for Research, St. Teresa's college (Autonomous), Ernakulam.

PLACE: Ernakulam

DATE:

NAME: ASHNA SHAJI

(Reg. No. AB20BOT012)

CONTENTS

SL NO.	TITLE	PG NO.
1	INTRODUCTION	1-4
2	OBJECTIVES OF THE STUDY	5
3	STUDY AREA	6-8
3	REVIEW OF LITERATURE	9-11
4	MATERIALS AND METHODS	14-16
5	RESULT	15-20
6	DISCUSSION	21-22
7	BIBLIOGRAPHY	23-26

List of figure

SL NO	TITLE
1	PLATE 1: Map of study area
2	PLATE 2: <i>Riccia billardiereri</i>
3	PLATE 3: <i>Cyathodium cavernarum</i>
4	PLATE 4: <i>Fossombronia japonica</i>
5	PLATE 5: <i>Lopholejunea subfusca</i>
6	PLATE 6: <i>Thysananthus humilis</i>

INTRODUCTION

Bryophytes are a group of land plants, sometimes treated as a taxonomic division that contains three groups of non-vascular land plants: the liverworts, hornworts and mosses. Bryophytes are characteristically limited in size and prefer moist habitats although they can survive in drier environments. The bryophytes consist of about 30,000 plant species around the world. Bryophytes produce enclosed reproductive structures (gametangia and sporangia), but they do not produce flowers or seeds. They reproduce sexually by spores and asexually by fragmentation or the production of gemmae. Though bryophytes were considered a paraphyletic group in recent years, almost all of the most recent phylogenetic evidence supports the monophyly of this group, as originally classified by Wilhelm Schimper in 1879. The term bryophyte comes from Ancient Greek βρύον (brúon) ‘tree moss, liverwort’, and φυτόν (phutón) ‘plant’.

Bryophytes exist in a wide variety of habitats. They can be found growing in a range of temperatures (cold arctic and in hot deserts), elevations (sea-level to alpine), and moisture (dry deserts to wet rain forests). Bryophytes can grow where vascularized plants cannot because they do not depend on roots for uptake of nutrients from soil. Bryophytes can survive on rocks and bare soil.

LIVERWORTS

It is estimated that there are about 7500 species (Söderström et al., 2016) of liverworts. Some of the more familiar species grow as a flattened leafless thallus, but most species are leafy with a form very much like a flattened moss. Leafy species can be distinguished from the apparently similar mosses on the basis of a number of features, including their single-celled rhizoids. Leafy liverworts also differ from most (but not all) mosses in that their leaves never have a costa (present in many mosses) and may bear marginal cilia (very rare in mosses). Other differences are not universal for all mosses and liverworts, but the occurrence of leaves arranged in three ranks, the presence of deep lobes or segmented leaves, or a lack of clearly differentiated stem and leaves all point to

the plant being a liverwort. Liverworts are distinguished from mosses in having unique complex oil bodies of high refractive index. It may be found growing on soil, bark, and even on the leaves of other plants of misty tropical forests. Compared to mosses, these plants may be adding more visual richness to the tropical forests. However, they are least considered even by the mainstream field botanists. Their comparatively small size, lack of proper resources and difficulties in identification had made it an enigmatic group even among the practising bryologists.

Liverworts are typically small, usually from 2–20 mm wide with individual plants less than 10 cm long, and are therefore often overlooked. However, certain species may cover large patches of ground, rocks, trees or any other reasonably firm substrate on which they occur. They are distributed globally in almost every available habitat, most often in humid locations although there are desert and Arctic species as well. Some species can be a nuisance in shady greenhouses or a weed in gardens.

The term liverwort originated from the fact that the early herbalists thought that one of the liverworts had some resemblance to a liver – and some use as medicine for liver ailments. Hence the word liverwort for a “liver-like small plant. People make medicine out of the fresh or dried parts that grow above the ground. Despite serious safety concerns, liverwort is used for treating gallstones and liver conditions including jaundice, liver enlargement, hepatitis, and liver cirrhosis.

Liverworts are distributed worldwide, though most commonly in the tropics. Thallose liverworts, which are branching and ribbonlike, grow commonly on moist soil or damp rocks, while leafy liverworts are found in similar habitats as well as on tree trunks in damp woods. The plants are not economically important to humans but do provide food for animals, facilitate the decay of logs, and aid in the disintegration of rocks by their ability to retain moisture.

Liverworts were formerly placed in the division Bryophyta with the mosses; however, phylogenetic evidence has led to a reorganization of their taxonomy. The division consists of three classes and six or seven orders, which

are segregated primarily on gametophyte structures, with sporophyte features also supporting the classification.

Sexual (gametophyte) and asexual (sporophyte) generations characterize a liverwort life cycle. The gametophyte generation consists of the haploid thallus and is the dominant generation; it develops from a germinating spore. Sperm from the male reproductive organ (antheridium) travel through an aqueous environment to fertilize the eggs that are still retained in the female reproductive organ (archegonium). The sporophyte generation develops from this diploid embryo and forms a sporangium at its apex. Spores are released when the sporangium ruptures, marking the start of a new gametophytic generation.

Most liverworts can reproduce asexually by means of gemmae, which are disks of tissues produced by the gametophytic generation. The gemmae are held in special organs known as gemma cups and are dispersed by rainfall. Fragmentation of the thallus can also result in new plants. Single-celled structures called rhizoids anchor most liverworts to their substrata.

The most ancient liverwort fossils known provide the earliest evidence of plants colonizing the land. These fossils, which appear as cryptospores (sporelike structures), were discovered in Argentina in rocks dating to between 473 million and 471 million years ago. In India studies on liverwort estimated about more than 3000 species and Kerala with 250 species (Manju & Rajesh, 2017). The present study reports analyzed a preliminary survey of Liverwort diversity of St. Teresa's college and documented five species including both leafy and thalloid form of liverworts.

OBJECTIVES

1. Exploration of the Liverworts of St. Teresa's College campus
2. Preparation of taxonomic account of the Bryophytes collected from the study area along with critical notes
3. Description giving anatomical and morphological details of all the species
4. Photographic documentation of all the species
5. Enrichment of the Bryophyte collection of Botany department herbarium of St. Teresa's College Ernakulam

STUDY AREA

The present study is conducted in St. Teresa's College of the Ernakulam district. It is the seventh district in the state of Kerala. Ernakulam is the Central Business District of the city of Kochi in Kerala, India and has lent its name to the Ernakulam district. Ernakulam bordering the district of Thrissur in the north, Idukki in the East, Alappuzha and Kottayam in the south, Lakshadweep Sea in the west is an amalgam of a hoary heritage and global growth of industry and commerce. For the outside world, Ernakulam is part of Kochi, referred to in the history of Kerala as the Queen of Arabian Sea.

The densely populated Ernakulam District embodies the achievements of the Kerala State in literacy, industry, trade and commerce. Many major establishments, including the Kerala High Court, the office of the Kochi Municipal Corporation and the Cochin Shipyard are situated here. The Ernakulam District is situated in Central Kerala in India. Ernakulam is located at 9.98°N 76.28°E. It has an average elevation of 4 m (13 ft).

Under the Köppen climate classification, the city of Ernakulam features a Tropical monsoon climate. Since the region lies in the south western coastal state of Kerala, the climate is tropical, with only minor differences in temperatures between day and night, as well as over the year. Summer lasts from March to May, and is followed by the South-west monsoon from June to September. October and November form the post monsoon or retreating monsoon season. Winter from December through February is slightly cooler, and windy, due to winds from the Western Ghats.

The Ernakulam district covers an area of 3,068 km² (1,185 sq mi) on the Western Coastal Plains of India. It is surrounded by the Thrissur District to the north, the Idukki District to the east, Alappuzha and Kottayam districts to the south and the Laccadive Sea to the west. The Anamalais occupy a large part of the district, consisting of the forest areas around Pooyamkutty and the Idamalayar Dam. The range also extends into Thrissur, Palakkad, and Idukki districts, as well as Coimbatore and Tiruppur districts of Tamil Nadu.

The district is divided geographically into highland, midland, and coastal areas. The altitude of the highlands is about 300 m (980 ft). The Periyar River, Kerala's longest, flows through all the taluks except Muvattupuzha. The Muvattupuzha River and a branch of the Chalakudy River also flow through the district. The average yearly rainfall in the district is 3,432 mm (135.1 in). The district has a moderate climate and mostly falls within the Malabar Coast moist forests ecoregion, while the highlands are part of the South Western Ghats moist deciduous forests ecoregion.

The present study involves the collection of bryophyte specimens from the St. Teresa's College of Ernakulam district. St. Teresa's College (Autonomous) Ernakulam, Kerala, a pioneering institution committed to the cause of higher learning of women and their empowerment through excellence in teaching, learning and research, was established on 15th June 1925 by the Carmelite Sisters of St. Teresa under the leadership of the visionary foundress Mother Teresa of St. Rose of Lima – a legend who opened up a glorious page for the empowerment of women, and who was declared as Servant of God on 29 January 2016. This 98 year old premier Minority Institution provides education in line with the mission of the foundress, aimed at the integral formation of intellectually creative, emotionally mature, morally responsible, spiritually enlightened, socially committed and truly liberated women who will reposition themselves as self-reliant and responsible individuals and agents of change who will transform society. St. Teresa's College is the first women's College in Kochi and the second in the state of Kerala. It holds the honour of being the first aided College for women in the state. It was first affiliated to Madras University then to Kerala University. In 1983 it became one of the affiliated colleges of Mahatma Gandhi University. It was accredited by the NAAC at 'five star' level in 1999, re-accredited at 'A- level' in 2006 and reaccredited at 'A' level in 2012. The autonomous status was granted in 2014 recognizing its potential to become the first Deemed Women's University in the state of Kerala. Recognizing its academic excellence, the college was granted an extension for two years by the NAAC.(Plate 1)

The campus is situated in the heart of Kochi city in three different locations separated by a distance of roughly half a kilometre. The Arts Block is on

the Park Avenue road occupying two acres and 65 cents. The Science Block on T.D road is situated in an area of one acre and 34 cents and the New Central block situated right in between both Arts and Science Campus at Convent road. Each block has many buildings with an adequate number of classrooms for different programmes offered by the college. The Topography, flora of the campus mainly represented with *Albizia saman*, *Annona squamosa*, *Artocarpus heterophyllu*, *Azadirachta indica*, *Mangifera indica*, *Borassus flabellifer L*, *Saraca ashoka*. The present study involves the collection of bryophyte specimens from different habitats of college campus.

REVIEW OF LITERATURE

Liverworts are the first group of land plants characterized by green dorsiventral thallus. Systematic studies on Hepatic flora of different localities have frequently perused in various parts of the world as well as in India. Lindenberg and Lehman (1832) have studied some liverworts of India and Nepal. The catalogue of Dr. Wallich, reproduced by Royle (1839) includes a brief note on the hepatics. Lindenberg and Nees (1844, 1847) have been given an account of some of the Indian liverworts collected by Wallich and Wight from the Himalayas. The posthumous memoirs of Griffith (1849) may perhaps be considered as the first noteworthy contribution to Indian bryology in its early days. The Major works on liverwort as well as Bryophytes in Kerala initiated by Manju et al (2005) in bryophytes of Wayanad in the Western Ghats. Later Manju et al (2008) published checklist of Bryophytes revealed 148 taxa of liverworts, this study revealed the diversity of liverworts in Kerala

Subhisha et al. (2005) Antifungal activities of a steroid from *Pallavicinia lyellii*, a liverwort. From *P. lyellii* a steroidal fraction with remarkable in vitro antifungal activity has been isolated. Pocs et al. (2007) Liverwort (Marchantiopsida) records from the Western Ghats (Kerala State, Peninsular India).Records of 33 hepatic taxa collected in the Kerala State of southern India, of which *Heteroscyphus splendens*, *Lejeunea eifrigii*, *L. pallide-virens*, *Leptolejeunea balansae* and *Mastigolejeunea indica* are new for the whole of India or at least for its continental part.

Ramesh et al. (2009) recorded Ethnobryological notes from Western Ghats, India, documented ethnobryological notes on the liverwort *Targionia hypophylla* to cure scabies, itches and other skin diseases by the Irula tribes and the leafy liverwort *Frullania ericoides* for head lice (*Pediculus humanus*) and nourishment of hair by the Mudugar tribes. Saxena and Singh (2010) Conducted Study on antibacterial activity of Liverwort, *Astrella Angusta*. Manju et al. (2011) *Exormotheca tuberifera* Kashyap a rare liverwort is reported from Kerala part of the Western Ghats of India. Söderström et al. (2011) conducted the first ever liverwort and

hornwort checklist for Jamaica. Reported 332 taxa in 314 species, 14 of which are invalid, illegitimate or in orphaned genera.

Krishnan et al. (2014) Axenic culture of bryophytes: A case study of liverwort *Marchantia linearis* Lehm. & Lindenb. Conducted Axenic cultures of *Marchantia linearis* Lehm. & Lindenb. were established by propagating spores (explant) in vitro. Verma et al. (2015) *Plagiochila sisparensis* Steph. Prajitha et al. (2017) the paper reports the occurrence of *Nardia assamica* (Mitt.) Amakawa, belonging to the family Jungermanniaceae, a rare leafy liverwort from Malabar Wildlife Sanctuary, Kerala. Manju et al. (2017) *Cololejeunea manilalia* sp. nov., an epiphyllous leafy liverwort, collected from the high altitude, tropical wet evergreen shola (cloud forest) of the New Amarambalam Reserved Forest in the Western Ghats of India. Manju et al (2017) published a book liverworts of Kerala documented with 101 species.

Mufeed et al (2018) *Colura calyptrifolia* (Hook.) Dumort. A very small and rare interesting epiphytic species of the family Lejeuneaceae is reported for the first time from Anamudishola National Park in the Western Ghats of Kerala. Mufeed et al. (2018) a rare liverwort *Gottschelia schizopleura* (Spruce) Grolle, of Jungermanniales is discovered from the Western Ghats. Deepa et al. (2019) *Wiesnerella denudata* (Mitt.) Steph., a complex thalloid liverwort in the family Wiesnerellaceae (Marchantiales), is reported as a new species to Peninsular India from the Anamudi Shola National park in the Western Ghats of Kerala.

Benny and Mathew (2020) Taxonomic studies on leafy liverworts and mosses from Ernakulam district, Kerala, India and documented leafy liverworts and Bryopsida from Ernakulam district. Among the 28 bryophytes identified, 11 of them belong to leafy liverworts and the rest belongs to mosses. James et al. (2020) worked out on tow selected liverworts *Marchantia emarginata* and *Lunularia cruciata* L. Dum ex. Lindb and a comparative assay of their phytochemical and antibacterial properties. Chandini et al. (2020) studied the Diversity of the genus *Drepanolejeunea* (Spruce) Schiffn. of the family Lejeuneaceae in

Kerala is discussed in detail. So far, 8 species have been reported from the Western Ghats, of which 6 occur in Kerala. This paper provides detailed descriptions of 5 of the species collected from Kerala during the present survey. Among these, *Drepanolejeunea erecta* (Steph.) Mizut. is new to the Western Ghats, *D. fleischeri* (Steph.) Grolle & Zhu, *D. pentadactyla* (Mont.) Steph. and *D. ternatensis* (Gottsche) Steph. are new records for Kerala.

Sreenath et al. (2021) two genera of liverworts and eight genera of mosses representing 3 species and 12 species respectively are being reported as new distributional records for bryophyte flora of Andhra Pradesh. Subin et al. (2021) GC-MS Analysis of a Fragrant Epiphyllous Liverwort *Leptolejeunea balansae* from Western Ghats, India. A fragrant epiphyllous liverwort was found on the leaves of an endangered tree during a forest trip and the Specimen identified as *Leptolejeunea balansae* Steph. Manju et al. (2021) A new species of Riccia, *R. keralensis* sp. nov. of the subgenus *Riccia* of section *Riccia* and group Squamatae is described from the disturbed low land areas of Kozhikode and Malappuram districts of Kerala, India.

MATERIALS AND METHODS

The taxonomic study heavily depends on the type, quality and condition of the preserved material in the herbarium. Bryophytes are a diverse group of distantly related non-vascular plants usually inhabiting the amphibious habitat, ranging from soil, rocks, barks, logs, twigs and leaves. The life cycle consists of two distinct phases-gametophyte and sporophyte, hence a complete bryophyte herbarium needs vegetative as well as reproductive phase for perfect identification. The materials for the present study were collected during October 2022 to February 2023

Collection

A systemic collection provides the basis for taxonomic research. Careful examination of a limited area is more fruitful than visiting different places, since the species is distributed in specific areas. These plants are very delicate and small hence were handled carefully. Plants were scraped out from the substratum with the help of a sharp edged knife. The bulk of the soil attached to the material was removed, leaving a thin layer attached. Two or more species may grow together, hence were collected together by giving the same field number and separated later into different packets assigning the same number with serial numbers. The plants were dried keeping them in between the blotting papers or newspapers. The field data including date, locality, altitude, family, habit, habitat, name of collector, notes etc. were also noted down. The name of genera/species and their associates were added after careful examination.

Preservation

The preservation technique for mosses and liverworts varies. Liverworts were preserved both as wet and dried forms. During our present study we preserved the material as dried specimens in paper packets; they regained its original shape and size, and to some extent colour also. The materials kept in paper packets will remain fresh and alive for some days so that it can be examined alive, which later may be dried and stored in the herbarium cabinet in Botany department of St. Teresa's College.

Investigation and Identification

Fresh materials were subjected to study, whenever possible, for identification. External morphological features were studied under a simple dissection microscope and internal features by a compound microscope (Olympus CX31). Size of leaves, cells and capsule were measured by micrometry. Identification of specimens was done with the help of our research guide Dr. Chandini V. K and by referring authentic literatures (Mufeed *et al.*, 2021, Manju & Rajesh, 2017, Daniels, 2013, Gangulee, 1967-74; Nair *et al.* 2005; Singh & Nath, 2007). Photographs of the habitat were taken using Mobile Camera and microphotographs under the microscope were taken using a digital camera model (Magnus pro) attached with microscope.

Taxonomic description

Detailed descriptions were given for each genus and species whenever it was needed. Authors of plant names are abbreviated based on Brummitt and Powell (1992) and titles journals were based on taxonomic literature (Stafle and Cowan, 1976-1994). The taxa are arranged according to the classification of Shaw and Goffinet (2000) and Stotler *et al.* (2009). All the genera and species under the family are arranged alphabetically each species is described with up to date nomenclature, brief description of available characters such as leaves, cells, capsule, etc. The citations are limited to the publications relevant to Indian context. Dichotomous keys have been provided for species on the basis of reliable characters. Photographs of habit and habitat of each species were also provided as far as possible.

Plan of the Dissertation

The dissertation is divided into six sections as Introduction, Study area, Review of Literature, Materials and Methods, Results, Discussion and summary appended with Bibliography.

Introduction- includes general characters of bryophytes, characteristics of liverworts, objectives of the present studies and relevance.

Study Area -gives detailed description of its geography, climate, vegetation, and is supported with the map

Review of Literature- includes a general introduction on the work on bryophytes in India and Kerala and a special mention is given on review of work of liverworts done on Kerala

Materials and Methods- describe the methodology adopted for collection of herbarium, processing and general outline on how the descriptions were prepared.

Result- The results are summarized as five different species of liverwort. It is followed by a brief discussion on the habitat preference of the liverworts in the study area

Discussion and Summary - Discusses the general aspects of liverworts of St. Teresa's college, Ernakulum, much as the species distribution.

RESULT

Systematic treatment of the Liverworts of St Teresa's College, Ernakulam, Arts block, central block and science block.

Subkingdom: **BRYOPHYTINA OR BRYOBIOPHYTINA**

Plants free living, enjoy wide range of habitats. 1 mm to 40 m long, thallose, foliose or erect thalli prostrate, dorsiventral, in foliose form leaves uniseriate, midrib absent; in erect forms leaves uniseriate, midrib present or absent, when present multiseriate; shows alternation of generations, antheridia club shaped, archegonia flask shaped, sporophyte dependant on gametophyte for nutrition, usually differentiated into foot, seta and capsule, elaters present in liverworts and absent in mosses.

Division: **MARCHANTIOPHYTA (LIVERWORTS)**

Plants thallose to foliose, prostrate, dorsiventral, branches usually dichotomous, when foliose distinctly 2-3 ranked, underleaves when present smaller, lamina cells larger round or elongate, rhizoids aseptate; capsule rounded to cylindrical, seta elongate, mouth operculum and peristome absent.

Family: **RICCIACEAE** Rehb

Thallus yellowish-green to bluish or blackish green, prostrate, dichotomously branched; ventral scales in two rows; air space conspicuous, air pores rudimentary or absent; sex organs and sporogony immersed within the thallus, sporogonium without foot, seta and capsule, spores surrounded by single or double layered spore wall, spores rounded, brownish.

GENUS: **Riccia** L., Sp. Plant. 1138. 1753.

Thallus yellowish-green to bluish-green, dichotomously branched, usually forming rosettes on moist ground, rarely floating in water, with a distinct median furrow; ventral scales usually in one row at the apex, two rowed in the median line, hyaline, violet, light purple or brownish, rhizoids common on land forms, absent in aquatic forms, usually of two kinds smooth and tuberculate photosynthetic layer with narrow air spaces, or with large

polyhedral air chambers; storage region compact, antheridia and archegonia scattered in monoecious species, arise in the dorsal surface, sporophyte without foot and seta, calyptra wall two layered; spores separating before maturity, usually tetrahedral, rarely isobilateral, in some species permanently united in tetrad, sterile cells absent.

Riccia billardierei Mont. et N., Syn. Hep.: 602, 1844.

Monoecious, formed in overlapping patches or in incomplete rosette, light greenish, repeatedly dichotomously branched, apical notch very prominent, mid dorsal line narrow, rhizoids both the types, scales very prominent, semilunar, purplish, tubers on the dorsal surface; photosynthetic filaments closely arranged, air chamber narrow, epidermis uniseriate, cells globose; sporogonia in 1-3 rows, exposed out by the disintegration of dorsal tissue; spores reddish brown, 90- 130 um, areolate, 4-8 areolae across diameter, wider at proximal phase and less wider at distal phase, triradiate mark inconspicuous. (Plate 2)

Habitat: on soil

Specimen examined: Ernakulam, St Teresa's college, Science block, 16/2/2023, *Ashna and Lekshmi Priya 54*

Distribution: Widely distributed species in India (Karnataka, Tamil Nadu, Andhra Pradesh, Himalaya, Madhya Pradesh, Rajasthan, Western Ghats of Gujarat, Maharashtra, Punjab, Uttar Pradesh, Bihar, Andaman & Nicobar Islands); Pakistan, Srilanka, Indonesia, Japan, South Africa and Bangladesh.

Family: **CYATHODIACEAE** Stotler & Crand.-Stotl.

Thallus differentiated, with simple air pores; ventral scales in 2 rows, minute, without appendages; rhizoids mostly smooth, a few pegged; perigonial chambers embedded dorsally on ventral or apical thallus branches; sporophytes ventral at the thallus apex; involucre bivalved; pseudoperianths absent; seta remaining short; elaters few per capsule; capsule dehiscence by a lid and irregular valves; asexual reproduction by fragmentation of the thallus margin.

GENUS: ***Cyathodium*** Kunze, in Lehm. Nov. Stirp. Pug, 6: 17. 1835.

Thallus fluorescent greenish, thin, tufted, dichotomously divided; air chambers in one layer, empty or with assimilatory filaments, pores when present large, bounded by concentric rings of cells; scales minute in two rows or absent, rhizoids smooth; male receptacle terminal, lateral or in the forking of two branches, antheridia numerous, involucre smooth or hairy; archegonia few in a cluster. (Plate 3)

Cyathodium cavernarum Kunze in Lehm., Nov. Stirp., Pug. 6:18.1834

Thallus yellowish-green to light greenish or fluorescent green, thin, delicate, 4-10 x 4-5 mm, often dichotomously branched; dorsal epidermal cells thin walled, chlorophyllose; air chambers in single row, partition between air chambers 1-2 cells high with chloroplasts, pores on dorsal surface with 3-4 concentric rings of 4-6 cells; rhizoids smooth walled. (Plate 3)

Habitat: Occurs in moist areas of soil, wet rocks and brick walls

Specimen examined: Ernakulam, St Teresa's College, 11/11/2023 *Ashna and Lekshmipriya* 20, 41, 55.

Distribution: Widely distributed species of low to high altitude areas in India and world.

Family: **FOSSOMBRONIACEAE** Hazsl

Plants yellowish to greenish, prostrate to procumbent, delicate; leaves lobed, uniseriate, margins wavy, possess slime papillae; sporophyte differentiated into foot, seta and capsule, protected by a bell shaped pseudoperianth when young capsule globose; spores numerous, rounded, yellowish-brown.

GENUS: *Fossombronia* Raddi, Mem. Soc. Ital. Sci. Modena 18: 20. 1820.

Plants green to yellowish-green, delicate, solitary or in patches; stem simple, prostrate, sometimes slightly raised towards the apex, dorsally flattened with or without apical tubers, rhizoids hyaline or purple coloured; leaves simple, quadrate to subquadrate, usually broader than long, narrow at base, succubous, obliquely inserted in two lateral rows, each lobe having a single

mucilage papilla at apex, cells thin walled, angular, filled with chloroplast; monoecious or dioecious, antheridia seen singly on the dorsal surface of the stem or sometimes aggregated towards apex at the base of young leaves, archegonia dorsal on stem; pseudoperianth distinct; seta short or long; capsule spherical, dark-brown to blackish, calyptra free, spores yellowish brown to dark brownish.

Fossombronina japonica Schiffn., Österr. Bot. Z. 49 (11): 389. 1899

Plants medium-sized, 2-3 mm wide and 2-10(-12) mm long, green, Leaves imbricate, subquadrate to broadly oblong-lingulate, towards apex rounded to truncate; margins slightly undulate, irregularly dentate. Oil-bodies 9-21 per cell, spherical to ellipsoidal, very small, Rhizoids scattered along the ventral surface of the stem, deep purplish. Sporophyte not seen. (Plate 4)

Habitat: On brick wall

Specimen examined: Ernakulam, St Teresa's college, Arts block, near canteen, 11/11/2023 *Ashna and Lekshmipriya - 46*

Distribution: The species widely distributed in India (Tamil Nadu, Kerala), Japan, New York, North America and West Virginia

Family: **LEJEUNEACEAE** Rostovzev

Plants light yellowish to greenish, leafy, very small to medium sized, 0.5 mm-2 cm long, prostrate, branching lateral, leaves alternate, incubous, leaf lobules distinctly saccate, attached to stem, inflated to elongate underleaves present or absent, if present distinct, bracts, bracteoles and perianth prominent, capsule globose, elaters monospiral.

Genus: *Lopbolejeunea* (Spruce) Schiffner, Engler & Prantl, Nat. Pflanzfam. 1(3): 119, 129. 1893

Plants dark greenish, creeping, long, irregularly branched, leaf lobes imbricate to oblong, apex rounded to incurved, leaf lobules small, ovate, slightly inflated, underleaves imbricate, orbicular to reniform, leaf cells with large trigones and small intermediate thickening, male bracts mostly ovate, 4-8

pairs, lobules oblong, obtuse at apex, female bracts ovate to acute and incurved at apex, irregularly dentate on margins, lobules rectangular, acute at apex, entire to irregularly dentate on upper margins

Lopholejeunea subfusca (Nees) Schiffn.

Plants dark brownish, 4-12 mm long, stem brownish, usually branched, leaf lobe rounded, margin entire, leaf cells thick walled with distinct trigones and intermediate nodules, leaf lobules small, ovate under leaves wider than long, margin entire, apex rounded, rhizoids at the base of under leaves. (Plate 5)

Habitat: On tree bark

Specimen examined: Ernakulam, St Teresa's college, science block (Garden). 11/11/2023 *Ashna and Lekshmi Priya 3*

Distribution : Widely distributed species in India (Meghalaya, Khasi Hills, Kerala, Tamil Nadu), Java, Philippines, New Guinea, Japan and Africa

Genus: ***Thysananthus*** Lindenb., Nov. Stirp. Pug. 8: 24, 1844 (Lehmann 1844).

Plants glossy green or dull green in live condition, dark brown to blackish in older portions, when dry pale yellow to yellowish brown to dark brown, irregularly pinnate, dendroid and regularly pinnate, ascending to erect or pendent, branches *Lejeunea*-type, leaves imbricate, when dry usually suberect and appressed or convolute, rarely spreading and flat, when moist weakly convex with apical part plane and not recurved, to strongly convex with apical part turned to ventral side and recurved, to subsquarrose, leaf lobe symmetrical or asymmetrical, ovate to ligulate, apex rounded, obtuse, acute or apiculate, dorsal base cordate or auriculate, dorsal margin entire or toothed, plane or incurved, cells elongate hexagonal, rarely subsodiametric, trigones cordate, often large and coalesced, intermediate thickenings absent, lobules ovate to oblong-rectangular, $2/3-1/2$ as long as lobe length, inflated, lobule apex oblique or truncate, keel smooth, underleaves distant to imbricate, slightly squarrose, broadly orbicular to spatulate, apex rounded to truncate, entire or toothed, plane, recurved or incurved, margins entire, recurved, bases cuneate or auriculate, dioicous or monoicous; androecia terminal to intercalary on

Lejeunea-type branches, bracts and bracteoles in 2–24 pairs, bracts epistatic or hypostatic, bracteoles similar to underleaves; antheridia 1–2 per bract; gynoecia terminal on elongate branches, with 1–2 lejeuneoid innovations, innovations repeatedly fertile, forming a monochasial or dichasial pattern, capsule globose, dark-brown to blackish, dehiscing from the apex, elaters with one brown spiral band, 66–82 per capsule, spores subisodiametric to oblong.

Thysananthus humilis (Gottsche) Sukkharak & Gradst., *Phytotaxa* 326(2): 102. 2017.

Plant dark green, dark brown when dried, 15-20 mm long, 1-2 mm wide including leaves, rhizoids few attaching on the base of underleaves; leaves densely imbricate, widely spreading, lobes convex, ovate to oblong, margin entire, apex obtuse-apiculate, leaf lobule, oblong, rectangular, free margin with 1-3 teeth, 1-3 cells long, usually 2, and 1-2 cells wide at base, keel straight, underleaves strongly imbricate, obcordate or widely ovate, margin entire (Plate:6)

Habitat: Epiphytic on bark

Specimen examined: Ernakulam, St Teresa's college, Central block, 11/11/2023 *Ashna and Lekshmi Priya* 8

Distribution: India (Assam, Meghalaya, Manipur, Tamil Nadu, Kerala), Australia, Bangladesh, Indonesia, Sri Lanka, Papua New Guinea

DISCUSSION

A systematic collection provides the basis for taxonomic research. Careful examination of a limited area is more fruitful than visiting different places. The present study is aimed mainly to document the Liverworts diversity of St Teresa's College, Ernakulam. The critical study of about 15 specimens of liverworts collected from the urban area of St Teresa's College Ernakulam distributed in 3 blocks (science block, Arts block, central block) during October 2022 to February 2023. Among the 15 liverworts 5 taxa were identified.

The present collection of 15 taxa belongs to 5 genera and 4 families. The family Ricciaceae, Fossombroniaceae, Cyathodiaceae represented a single genus. The frequency of occurrence of *Cyathodium cavernarum* is high. The collection of *Fossombronia* species is of rare occurrence. Family Lejeuneaceae is represented with two species viz *Lopholejeunea subfusca* and *Thysanathus humilis*.

Among the liverworts collected from the study area includes both thalloid (Two in number) and leafy types (Three in number). Leafy forms mainly prefer to grow on bark and are rarely seen on the brick wall. Thalloid species are common in terrestrial habitat, mainly on soil and land cuttings. The plant body of *Riccia* grows predominantly on damp soil and moist areas particularly during and after rain. *Cyathodium* occurs in moist areas in study areas; on soil, wet rocks and walls. *Fossombronia* species occur on small pockets of exposed soil and walls often in seasonally dry habitats.

The habitat of all the species varies; some species grow intermingled with moss species. Terrestrial species are most common in the study area. Among the terrestrial habitat soil harbours species number is followed by land cuttings. *Riccia* and *Cyathodium* are the widely distributed species and prefer to grow in a wide range of moist habitats. Most of the Liverworts are usually found on very moist soil or rocks, in rather shady areas, often in the splash zone of creeks.

Compared to the moss species the occurrence of liverworts in the study area is very less. Analysis of both reproductive and vegetative characters is very

important for liverworts so seasonal wise analysis is very essential. The present study was conducted only in one rainy season so we couldn't observe reproductive structure of most of the species.

As we all know bryophytes prefer to grow in pollution free areas , but St Teresa's college is situated at Centre of city Ernakulam which is a densely polluted area. Still we could find 15 specimens of liverworts . A detailed exploration could reveal more on the bryophyte diversity in St. Teresa's college Ernakulam.

The bryophyte studies on the Kerala state is very less compared to the diversity of the topography, vegetation, area and climate. The number of researchers and research centres working on this group is also meager. The regional approach of studying the smaller areas with deeper intensity is probably the best method in developing a national database. The present work is significant in this aspect.

BIBLIOGRAPHY

Benny, M.E. and Mathew, A., 2020, September. Taxonomic studies on leafy liverworts and mosses from Ernakulam district, Kerala, India. In AIP Conference Proceedings (Vol. 2263, No. 1, p. 030013). AIP Publishing LLC.

Chandini, V.K., Mufeed, B., Nair, M.C. and Rajesh, K.P., 2020. The genus *Drepanolejeunea* (Spruce) Schiffn.(Lejeuneaceae; Marchantiophyta) in the Western Ghats with special reference to Kerala. *Plant Science Today*, 7(3), pp.483-500.

Crandall-Stotler, B., Stotler, R.E. and Long, D.G., 2009. Phylogeny and classification of the Marchantiophyta. *Edinburgh journal of botany*, 66(1), pp.155-198.

Deepa, K.M., Mufeed, B. and Manju, C.N., 2019. *Wiesnerella denudata* (Mitt.) Steph.(Marchantiales; Marchantiophyta) a rare species in the Western Ghats of India. *Lindbergia*, 2019(1), pp.1-4.

Griffith, W. 1849. *Natulae and Plantae Asiaficae*, Calcutta.

<http://the.plantlist.org/browse/B/>

<http://tropicos.org/Name>

<https://goo.gl/maps/cFn3FWDvpRjZ8Asb8>

<https://goo.gl/maps/NMhf1Ef3GBZrNcJ77>

<https://kochicorporation.lsgkerala.gov.in/en/map/299>

<https://www.google.com/maps/place/ST.+TERESA'S+COLLEGE>

James, J.M., Aiswarya, M.S. and Vishnupriya, K.S.A., 2020. Comparative Phytochemical and Antibacterial Analysis of Two Selected Liverworts

(*Lunularia cruciata* (L.) Dum Ex. Lindband *Marchantia emarginata*) of Kerala. *Plant Arch*, 20, pp.6959-6965.

Krishnan, R. and Murugan, K., 2014. Axenic culture of bryophytes: A case study of liverwort *Marchantia linearis* Lehm. & Lindenb.

Lindenberg and Nees 1844, 1847. cf. Udar R. 1976 Introduction, In : *Bryology in India*. Udar R. (ed.) The chronica Botanica Co. New Delhi 1976, p.1.

Lindenberg J.B.W. and Lehman, J.G.C. 1832. *Novarum et minus cognitarum stirpium. Pugillus IV*

Manju, C.N. and Rajesh, K. P. 2017. *Bryophytes of Kerala, Liverworts Volume 1*. Centre for Research in Indigenous Knowledge, Science & Culture (Calicut, India).

Manju, C.N., Chandini, V.K. and Rajesh, K.P., 2017. *Cololejeunea manilalia* (Lejeuneaceae, Marchantiophyta), a new species from the Western Ghats of India. *Acta Botanica Hungarica*, 59(1-2), pp.261-268.

Manju, C.N., Chandini, V.K., Singh, S.K. and Rajesh, K.P., 2021. A new species of *Riccia* (Ricciaceae: Marchantiophyta) from the Western Ghats of Kerala. *The Bryologist*, 124(3), pp.376-384.

Manju, C.N., Nikesh, P.R. and Rajesh, K.P., 2011. *Exormotheca tuberifera* (Marchantiophyta, Exormothecaceae) from the Western Ghats of Kerala, India. *Taiwania*, 56(4), pp. 330-332.

Manju C.N., Rajesh, K.P. and Madhusoodanan, P.V. 2008. Checklist of the Bryophytes of Kerala, India. *Tropical Bryology Research Report No. 7*: 1-24.

Mufeed, B., Chandini, V.K., Manju, C.N. and Rajesh, K.P., 2018. *Colura calyptrifolia* (Lejeuneaceae: Marchantiophyta) a rare leafy liverwort from the Western Ghats of India. *Nelumbo*, 60(2), pp.149-154.

Pócs, T., Nair, M., Rajesh, K. and Madhusoodanan, P., 2007. Liverwort (Marchantiopsida) records from the Western Ghats (Kerala State, Peninsular India). *Acta Botanica Hungarica*, 49(1-2), pp.121-129.

Prajitha, B., Rajilesh, V.K., Madhusoodanan, P.V. and Prakashkumar, R., 2017. *Nardia assamica* (Mitt.) Amakawa (Jungermanniaceae), from Malabar Wildlife Sanctuary, a new record for Peninsular India. *Research & Reviews: Journal of Botany*, 6(3), pp.11-13.

Remesh, M. and Manju, C.N., 2009. Ethnobryological notes from Western Ghats, India. *The Bryologist*, pp.532-537.

Royle, J.F. 1839. Illustrations of the botany and other branches of natural history of the Himalayan mountains I. London.

Sathish, S.S., Kavitha, R. and Kumar, S.S., 2013. Bryophytes in India-the current status. *Int J Res Eng Biosci*, 1(4), p.23.

Saxena, D. and Singh, A., 2010. Antibacterial Activity of Liverwort *Astellia Angusta* St. *The Journal of Indian Botanical Society*, 89(3and4), pp.278-280.

Singaram, I., Sharma, A., Pant, S., Lihan, M., Park, M.J., Pergande, M., Buwaneka, P., Hu, Y., Mahmud, N., Kim, Y.M. and Cologna, S., 2023. Targeting lipid-protein interaction to treat Syk-mediated acute myeloid leukemia. *Nature chemical biology*, 19(2), pp.239-250.

Söderström, L., Hagborg, A., Von Konrat, M., Bartholomew-Began, S., Bell, D., Briscoe, L., Brown, E., Cargill, D.C., Costa, D.P., Crandall-Stotler, B.J. and Cooper, E.D., 2016. World checklist of hornworts and liverworts. *PhytoKeys*, 59: 1-500

Söderström, L., von Konrat, M., Hagborg, A. and Sénéca, A., 2012. Early Land Plants Today—a community driven approach. *Studia Botanica Hungarica*, 43, pp.47-58.

Sreenath, A. and Rao, B.R.P., 2021. Two genera of Liverworts and Eight genera of Mosses, New records to Bryophyte flora of Andhra Pradesh, India. *Int. J. Adv. Res. Biol. Sci*, 8(7), pp.190-201.

Subhisha, S. and Subramoniam, A., 2005. Antifungal activities of a steroid from *Pallavicinia lyellii*, a liverwort. *Indian Journal of Pharmacology*, 37(5), p.304.

Subin, K., Jose, P.A., Tom, B., Nair, B. and Manju, C.N., 2021. GC-MS Analysis of a Fragrant Epiphyllous Liverwort *Leptolejeunea balansae* from Western Ghats, India. *Research Journal of Pharmacognosy and Phytochemistry*, 13(3), pp.115-118.

Verma, P.K., Rawat, K.K. and Alam, A., 2015. *Plagiochila sisparensis* Steph.-a vulnerable liverwort from Nilgiri Hills, Western Ghats. *Plant Science Today*, 2(4), pp.151-153.