Chapter – I

Pharmacognosy
1. Introduction

1.1 Introduction

The Indian systems of medicine consist of Ayurveda, Siddha, Unani, Homeopathy and therapies such as Yoga and Naturopathy. Some of these systems are indigenous and others have over the years become part of Indian tradition. Indian systems of health care deals with both the preventive and curative aspects of life. The cost of care using these systems is affordable, and hence these systems have wide acceptance among all segments of the population. There is renaissance of herbal and traditional system of medicine, as they are broadly considered safe. This system of medicine uses several herbs for the treatment of ailments.

According to World Health Organization (WHO) estimate that around 85 – 90 % of the world’s population consumes traditional herbal medicines. Developing countries like Tanzania (60 %), Rwanda (70%), India (70%), and Benin (80%) and developed countries Belgium (31%), USA (42%), France (49%) and Canada (70%) use herbal medicine for primary health. With world demand growing at 1% annually, the export market for medicinal plants appears to be growing faster than the Indian domestic market. India is one of the few countries where most of the medicinal and aromatic plants are cultivated and exported. The size of the herbal health care and personal care market in India is estimated to be between rupees 2500 – 3000 crores.

Natural products have been our single most successful source of medicines. There are at least 120 distinct chemical substances derived from plants that are
considered as important drugs currently in use in the world, while several other drugs are simple synthetic modification of the natural products.

1.2 The Importance of Pharmacognosy

Pharmacognosy is the scientific study of structural, physical, chemical and sensory characters of drugs from animal, plant origin and mineral sources. Pharmacognosy basically deals with the standardization, authentication and study of natural drugs. It is an emerging as interdisciplinary science that incorporates inputs from botany, organic and analytical chemistry, biology, fundamentals of pharmacology, biochemistry, genetics, horticulture, and biotechnology directed towards natural products based drug discovery. Much of the research in pharmacognosy has been done in identifying controversial species of plants, authentication of commonly used traditional medicinal plants through morphological, histological, physico-chemical and toxicological parameters.

Many of the traditional systems have records where one common vernacular name is supplied in place of two or more entirely different species. Ginseng, which is a common Indian drug, is sold under different names in the market. They are Chinese or Asiatic ginseng (Panax ginseng), American ginseng (Panax quinquefolius), Siberian ginseng (Eleutherooccus senticosus), Ayurvedic ginseng (Withania Somnifera) and Russian ginseng (Acanthaopanax senticosus), to name a few. In slimming drugs, “Fangji” a Chinese herb is used. But it is found that ‘Aristolochia fangchi’ has been mistakenly used instead of Stephania tetrandra. ‘Brahmi’ is a popular Ayurvedic drug used as a revitalizer. There are two plants in the market with the same name they are Centella asiatica and Baccopa moneri. These two plants are being used on a large scale by traditional physicians irrespective of their authenticity. In Ayurveda, rhizomes of
Polygonatum verticillatum (L.) Alt. (syn. Convallaria verticillata L.) and Polygonatum cirrifolium (Wall.) are used as Meda and Mahameda. However it is observed that in different places, different plant species are being used as Meda and Mahameda. By a systematic pharmacognostical study, one can justify the correct identification of the plant drug and find out adulteration if any. The roots of Vinca rosea and Prosopis julifera are morphologically similar. The roots of Vinca rosea curing cancer and having export value may be adulterated by the other plant viz. Prosopis julifera, Habenaria intermedia D.Don. and Habenaria edgeworthi Hook.f. are two plants known as Riddhi and Vriddhi in Ayurveda. Acharya Charaka and sushruta mentioned these drugs under Astavarga group. These are one of the endangered species which are going to be extinct due to heavy exploitation for medicinal purpose, poor regeneration, low seed germination and seedling establishment, habitat loss, grazing, forest fire, competition with other dominant species of community. Similarly in the past, roots of Ventilago maderaspatana were collected from Western Ghats, as the only source of ‘Ratanjot’. But it was substituted by Arnebia euchroma var. euchroma due to the similarity in yielding a red dye. So due to scarcity of these plant drugs in market some drugs are sold to be adulterated or substituted which leads to deteriorate the quality and efficacy of the drug. Sometimes shows toxic effect on body. Hence a systematic pharmacognostic studies on medicinal plants used by traditional medical practitioners is a compulsory one.

1.3 The need for standardization

Herbal medicine is a triumph of popular therapeutic diversity. Almost in all the traditional medicine, the medicinal plants play the major role and constitute the backbone for the same. World Health Organization (WHO) has been promoting
traditional medicines as a source of less expensive, comprehensive medical care, especially in developing and developed countries. These herbal medicines are easily available, cheaper, time tested and considered safer than some of modern synthetic drugs\textsuperscript{12}. To integrate and work with globalization, traditional medicine must reassess and open itself to the requirements of scientific rationality, convert itself in its diagnostic and therapeutic approach methods as well as in its deontology. It will thus ensure its influence, productivity, and progress as well as enhance its therapeutic efficiency and competitiveness. This requires the use of modern medicine’s diagnostic means and therapeutic control and it should involve chemical and pharmacological study of medicines in order to determine their components, its active principles, its toxicity, and posology. This will lead to their commercialization nationally as well as internationally\textsuperscript{13}. Recently WHO introduced guidelines on research and evaluation of traditional medicine and practice. This guideline has a major objective of developing traditional medicine which leads into standardized and scientifically validated drugs. This guideline aims to ensure quality and safety of botanicals before being evaluated for its efficacy. Thus pharmacognosy is playing paramount role in evolution of novel medicines taking lead from natural products. The various methods used to evaluate or standardize the drug are organoleptic, microscopic, biologic, chemical and physical methods\textsuperscript{2}. Organoleptic refers to the evaluation by means of the macroscopic appearance of the drug, its odour, taste, and the “feel” of the drug to touch. Microscopy is essential to study of adulterants in powdered plant and animal drugs. Powdered drugs possess few macroscopic features of identification other than colour, odour and taste; hence the microscopic characteristics are important. The pharmacologic activity of drugs has been applied to their evaluation and standardization. Due to the active constituents of natural drugs have been determined, chemical methods of evaluating
crude drugs and their products are employed. For many drugs, the chemical assay represents the best method of determining the official potency. Generally the physical constants are applied to the active principles of drugs such as alkaloids, volatile oils, and others.

The present study deals with the standardization of the medicinal plants, *Flacourtia indica* (Flacourtiaceae), *Flueggea leucopyrus* (Phyllanthaceae), *Stephania wightii* Dunn. (Menispermaceae) and *Ventilago maderaspatana* Gaertn. (Rhamnaceae).
2. Review of Literature

The scientific study which relates the culture of the people and plants is known as ethnobotany. ("ethnology" – study of culture and "botany" – study of plants). A botanist named John W. Harshberger in 1895 first used the term “ethnobotany”. Beginning in the 20th century, the field of ethnobotany experienced a shift from the raw compilation of data to a greater methodological and conceptual reorientation.

India poses very vast ethnobotanical knowledge from ancient time. Since the 1950s 10 books, 300 papers and dictionary of Indian folk medicine, which contains 2532 plants, have been published. India has about 45,000 plant species; medicinal properties have been assigned to several thousand. About 2000 figure frequently in the literature; indigenous systems commonly make use of 500\(^{14}\). An ethnobotanical study of medicinal plants in Agasthiyamalai region of Tirunelveli district was done by collecting information from the experienced medicinal practitioners of Kani tribes. Ten plants were collected, authenticated and information on their medicinal uses along with the parts used and mode of administration was enumerated. The phytochemical constituents present in their extracted materials were identified. Antibacterial activity of the extracts was analysed and zone of inhibition for different bacterial strains was reported\(^{15}\). *Poecilineron pauciflorum* is an endemic tree species, belonging to the family Clusiaceae. The plant parts were employed as a kani tribal medicine and were used for the treatment of Mendel disorder and infectious diseases, and for exorcism activities. Phytochemical studies on *Poecilineron pauciflorum* barks yield several xanthones, such as 1,6–dihydroxy–7– methoxyxanthone and 1,6–dihydroxy–7–methoxyxanthone, 6–O–β–d–glucoside in addition to 12 known compounds 1,5–dihydroxy–, 1,5–dihydroxy–3–methoxy–, 1,7–dihydroxy–, 1–hydroxy–7–methoxy–, 2–methoxy–, 4–methoxy–, 1,4,5–
18

trihydroxy–, 1,3,5–trihydroxy–, 1,3,6–trihydroxy–7–methoxy–, 1,3,7–trihydroxy–, 3–hydroxy–2– ethoxyxanthone and (–)–epicatechin were isolated from the barks of *Poeciloneuron pauciflorum*\(^6\). The investigation of ethnomedicinal survey of medicinal utilization among Kanikarans, 76 species of plants distributed in 64 genera belonging to 43 families were reported\(^7\). A. John De Britto and R. Mahesh (2007) reported that Agasthiyamalai Biosphere Reserve in Tirunelveli zones had five Kani tribal settlement surveys of ethnomedicinal utilization with more than 480 species of which only 70 species were reported during the field study 2006–2007\(^8\). There are five tribal groups, namely Mannan, Paliyn, Urali, Malyryan and Malampandanam with a total population of 2,166. The first three tribal were migrants from Tamil Nadu, *Anamirta cocculus* (L) Wt &Arn. (Menispermaceae) and other 14 plant species used by the tribes for child birth, mother care and to induce abortion were given\(^9\).

An indigenous knowledge associated with the use of plant species to cure animal, human and crop pest and disease management practice followed by Malayali tribals was reported. 191 plant species and various applications were given\(^{10}\). A total of 34 medicinal plants from 33 genera under 29 families were enumerated from kanyakumari district Tamil Nadu. Most of the plants were used for curing earache, skin diseases, fever, cold, headache, cough, urinary disorder, ulcer, etc. Out of 29 families, 26 families were nonspecific. Plants of Rutaceae were largely represented (4 species), followed by Euphorbiaceae and Sapindaceae\(^{11}\). In Kalakad–Mundanthurai Tiger Reserve of Western Ghats, Tirunelveli, Tamil Nadu, fifty medicinal plants belonging to 36 families were identified which had been employed by the Kanikkar, the predominant tribal community for the treatment of rheumatism\(^{12}\). The ethnic groups (Kani/Kanikaran) in Southern Western Ghats of India, traditional uses of 54 plant species belonging to 26 families
Fig. 2 Showing the field work – Interaction with Pitchandi Kani by the Research Scholar Mr. S. Pandarasivan at Mylar, Papanasam Hills.
were described. The documented ethnomedicinal plants were mostly used to cure skin diseases, poison bites, wounds and rheumatism\textsuperscript{23}. The traditional healers of Kancheepuram District, Tamil Nadu used 85 species of plants distributed in 76 genera belonging to 41 families to treat various diseases. The documented medicinal plants were mostly used to cure skin diseases, poison bites, stomachache and nervous disorders\textsuperscript{24}.

2.1 Past work on some important medicinal plants

India is a veritable emporium of medicinal and aromatic plants. It has been estimated that out of 15,000 higher plants occurring in India, 9,000 are commonly useful, of which 7,500 are medicinal, 3,900 are edible, 700 are culturally important, 525 are used for fiber, 400 are fodder, 300 for pesticide and insecticide, 300 for gum, resin and dye and 100 for incense and perfume\textsuperscript{25} It is estimated that local communities have used over 7,500 plants species. Indian flora has innumerable medicinal plants which are collected from forest by tribal villagers and many of the plants are exported to the developed countries. Thousands of publications are available about the importance of medicinal plants. The aim of this topic is to know the knowledge of Indian medicinal plants. After the interaction with the tribal people (Fig.2), the list some important medicinal plants, parts used and clinical use are collected and are presented in Table 1.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|l|}
\hline
\textbf{Name of the plant/Family} & \textbf{Parts used} & \textbf{Chemical constituents} & \textbf{Medicinal use} & \textbf{Ref} \\
\hline
\textit{Abrus precatorius} L. Fabaceae & Leaf, root, seeds & Precol, abrol, glycyrrhizin, abrasine & Leucoderma, skin disease, cold & 37 \\
\hline
\textit{Acalypha indica} L. Euphorbiaceae & Leaf & \(\beta\)-sitosterol, acalphamide, stigmasterol, acalphin & Pneumonia, asthma, laxative & 37 \\
\hline
\end{tabular}
\caption{Details of medicinal plants used by the Kanikars in the traditional healing arts of South India}
\end{table}
<p>| <strong>Achyranthus aspera</strong>&lt;br&gt;L. Var. aspera Amaranthaceae | Whole plant | Pentoriacontance, 6–pentariacontanone, hexatriacontane, tritriacontane | Abortifacient, tooth ache | 37 |
| <strong>Acrostichum aureum</strong>&lt;br&gt;Linn. Pteridaceae | Rhizome | quercetin 3–O–β–D–glucoside (I), ponasterone A. | To heal wounds and boils | 34 |
| <strong>Actiniopteris australis</strong>&lt;br&gt;(L.F), Link Pteridaceae | Leaves | Rutin, beta sitosterol, hentriacontol, hentriacontane | Digestive ailments | 26 |
| <strong>Aegle marmelos</strong>&lt;br&gt;(L.)Correa Rutaceae | Fruit, root | Psoralen, xanthotxin, dimethoxy comarin, scopoletin, temamid | Chronic diarrhea, | 37 |
| <strong>Allium cepa</strong>&lt;br&gt;L. Liliaceae | Bulb | Histidine, lysine, tryptophan, methionine, threonine, lucine, isoleucine | Diuretic, rubiacient, jaundice, biliousness, stimulant | 37 |
| <strong>Aloysia triphylla</strong>&lt;br&gt;Verbenaceae | Dried leaves | 6–hydroxylated flavones | Digested ailments | 45 |
| <strong>Amorphophallus Campanulatus</strong>&lt;br&gt;(Roxb.) Bl, Araceae | Corms | Tyrosinase I, laccase II | Piles and hemorrhoids | 26 |
| <strong>Andrographis paniculata</strong>&lt;br&gt;Nees Acanthaceae | Leaves and stem | deoxyandrographolide, andrographolide and neoandrographolide | Analgesic and antipyretic | 26 |
| <strong>Apama siliquosa</strong>&lt;br&gt;Lamk, Aristolochiaceae | Root | Chakranine | Chest pain | 30 |
| <strong>Asparagus racemosus</strong>&lt;br&gt;Willd, Asparagaceae | Tuber | Racemosol, shatavarin I – IV | Stomach pain and ulcer | 26 |
| <strong>Asystasia gangetica</strong>&lt;br&gt;Acanthaceae | Root | asysgangoside, salidrose, ajugol, apigenin apigenin and apigenin | Antidote to the scorpion sting | 26 |
| <strong>Bidens pilosa L.</strong>&lt;br&gt;Asteraceae | Leaves | Aesculetin, β–sitosterol, caffeine, etc | Stomach ache | 23 |
| <strong>Bidens tripartite</strong>&lt;br&gt;Asteraceae | Aerial parts | Xanthophylls, acetylenes, tannins | Diuretic, kidney problem | 46 |
| <strong>Biophytum sensitivum</strong>(Linn.)D C Oxalidaceae | Dry powder of whole plant | Orientin, isoorientin, isovitexin, epicatechin | Coolant | 26 |
| <strong>Blumea balsamifera</strong>&lt;br&gt;Asteraceae | Leaves | L–borneol, d–camphor | Antifebrile, fever, influenza | 46 |
| <strong>Blumea lacera</strong>&lt;br&gt;Asteraceae | Leaves | Flavonens | Anthelmintic | 46 |</p>
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
<th>Family</th>
<th>Part Used</th>
<th>Active Constituents</th>
<th>Uses</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borreria ocymoides</td>
<td>DC, Rubiaceae</td>
<td></td>
<td>Leaves</td>
<td>Isohamnetin</td>
<td>To heal wounds</td>
<td>23</td>
</tr>
<tr>
<td>Brassica juncea</td>
<td></td>
<td>Brassicaceae</td>
<td>Seeds</td>
<td>Sinigrine, gluconapin</td>
<td>Carminative, digestive</td>
<td>46</td>
</tr>
<tr>
<td>Caesalpinia bondoc</td>
<td>Root bark</td>
<td>Fabaceae</td>
<td></td>
<td>Caeslpin F</td>
<td>Emmenagogue</td>
<td>46</td>
</tr>
<tr>
<td>Cardiospermum halicacabum</td>
<td>B – sitosterol, β-D-glucoside, stigmasterol–β-D-glucoside, (+)-pintiol</td>
<td>Sapindaceae</td>
<td>Leaf</td>
<td>Headache, depressant, rheumatism, and joint pain</td>
<td></td>
<td>36 37</td>
</tr>
<tr>
<td>Carmona retusa (Vahl.) Masam, Cordiaceae</td>
<td>Whole plant</td>
<td>Chlorogenic acid, antimitagens</td>
<td>To cure tooth ache, to strengthen tooth</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Caryatia pedata Juss., Vitaceae</td>
<td>Leaves, fruit, stem</td>
<td>Sterol, waxy acids</td>
<td>Gastric complaints</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Cassia nigricans Vahl, Leguminosae</td>
<td>Aerial parts</td>
<td>Bis(ethyl hexyl) phthalate, β–sitosterol acetate, emodin</td>
<td>Antidote to snake bite, skin disease</td>
<td></td>
<td></td>
<td>26 27</td>
</tr>
<tr>
<td>Chamomilla recutita Asteraceae</td>
<td>Flowers</td>
<td>Coumarins, tannins</td>
<td>Antispasmodic, relaxant</td>
<td></td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Cichorium endivia Asteraceae</td>
<td>Flowers</td>
<td>Cichorin</td>
<td>Hepatitis</td>
<td></td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Citrus aurantifolia Rutaceae</td>
<td>Fruit</td>
<td>rutin, neohesperidin, hesperidin, hesperitin, limonexic acid, isolimonexic acid, limonin</td>
<td>Stomach disorder</td>
<td></td>
<td></td>
<td>17 41</td>
</tr>
<tr>
<td>Citrus medica L Rutaceae</td>
<td>Fruit</td>
<td>limettin, stigmasta–5, 22–dien–3–ol, palmillic acid</td>
<td>To increase the secretion of blood</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Clerodendrum trichotomum Verbenaceae</td>
<td>Leaves</td>
<td>Cleodendrin, acacetin</td>
<td>Joint pain, numbness</td>
<td></td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Curculigo orchoides Gaertn, Hypoxidaceae</td>
<td>Tuber</td>
<td>2,6-dimethylbenzoic acid, curculigoside, curculigosideB,C, curculigoside, orchoside</td>
<td>Sexual stimulant, Induce lactation in nursing mother</td>
<td></td>
<td></td>
<td>17 30 31</td>
</tr>
<tr>
<td>Cyclea peltata Hook.f.&amp; Thoms. Menispermacae</td>
<td>Whole plant</td>
<td>d–tetrandrine, dl–tetrandrine, d–isochondrodendrine, and fangchinoline</td>
<td>Diarrhea, wounds, skin disorder</td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Cymbopogon flexuosus Poaceae</td>
<td>Plant oil</td>
<td>1–bisabolone, limonene</td>
<td>Antipyretic</td>
<td></td>
<td></td>
<td>26</td>
</tr>
<tr>
<td><strong>Cyperus rotundus</strong></td>
<td>Tuber</td>
<td>α–Cyperone, myrtenol, caryophyllene oxide and β–pinene</td>
<td>Induce lactation in nursing mothers</td>
<td>26 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Daemia extensa</strong></td>
<td>Whole plant</td>
<td>β–sitosterol, lupeol, lupeol acetate, α, β–amyrin</td>
<td>To heal wounds</td>
<td>26 29</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Echinops setifer</strong>, <strong>Compositae</strong></td>
<td>Root</td>
<td>Echinopsine</td>
<td>Anti–tumor</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Eclipta alba</strong></td>
<td>Whole plant</td>
<td>Thiphene derivatives</td>
<td>Thermogenic, anti–helminthic</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Eclipta prostrata</strong></td>
<td>Whole plant</td>
<td>Eliptine</td>
<td>Smoke bite</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emilia sonchifolia</strong></td>
<td>Whole plant</td>
<td>Simiral, beta–sitosterol, stigmasterol, palmitic acid and honey acid.</td>
<td>Chest pain</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ficus hispida</strong></td>
<td>Fruits and bark</td>
<td>O–methyltylophorindine, ficustriol, etc.</td>
<td>Leucoderma</td>
<td>30 33</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gloriosa superb</strong></td>
<td>Tuber</td>
<td>Colchicines</td>
<td>Leprosy, piles, and colic, gonorrhea</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gymnema sylvestre</strong></td>
<td>Leaves</td>
<td>Hentiacontane, tartaric acid, inositol, d–quercitol, gymnemic acid</td>
<td>Diuretic</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gynandropsis gynandra</strong></td>
<td>Leaves</td>
<td>(20s,24s)–epoxy–19,25–dihydroxydammarane–3–one, hemiketal rutin, 5,7–dihydroxychromone, lupeol, luteolin</td>
<td>Analgesic</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Helicteres isora</strong></td>
<td>Fruit</td>
<td>Malatyamine, cucurbitainB, cucurbitainC, triterpenoids</td>
<td>Hair growth</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hemionitis arifolia</strong></td>
<td>Root</td>
<td>2–hydroxy–4methoxybenzaldehyde, essential oil, tannin</td>
<td>Tonic, in los of apatite, rheumatism</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hieracium pilosella</strong></td>
<td>Entire plant</td>
<td>Umbelliferone</td>
<td>Brucellosis</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ipomoea obscura</strong></td>
<td>Aerial parts</td>
<td>Ipomucrines, alkaloid ipomucrine–C, Indole compounds</td>
<td>To induce conception</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Launaea sarmentosa</strong> Asteraceae</td>
<td>Whole plant</td>
<td>Tavaxeryl acetate, taraxasterol</td>
<td>Diuretic, aperients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Marsilea minuta</strong> Linn. Marsileaceae</td>
<td>Whole plant</td>
<td>Marsiline</td>
<td>Haemorrhoids, dyspepsia, leprosy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mollugo nudicaulis</strong> Lam., Molluginaceae</td>
<td>Whole plant</td>
<td>Carotene, saponin</td>
<td>Fever</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mukia maderaspatana</strong> (L.)M.Roem. Cucurbitaceae</td>
<td>Leaves</td>
<td>Spinosterol, 22,23–dihydrospiasterol.</td>
<td>Liver dysfunction, hepatotonic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mussaenda hirsutissima</strong> Hutch. Rubiaceae</td>
<td>Leaves, stem</td>
<td>Phenols, flavonoids, syringils, tannins</td>
<td>To cure heel cracks, to cure sterility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ocimum americanum</strong> L. Lamiaceae</td>
<td>Leaves</td>
<td>Pilosin, nevadensin, xanthomicrol, gardenin B</td>
<td>To treat acne</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ocimum sanctum</strong> Lamiaceae</td>
<td>Whole plant</td>
<td>Eugenol, carvacrol</td>
<td>Demulcent, febrifuge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phyllanthus virgatus</strong> G. Forst., Euphorbiaceae</td>
<td>Leaves</td>
<td>Simplexine, phyllanthine</td>
<td>Jaundice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Piper longum</strong> L. Piperaceae</td>
<td>Leaves, fruit</td>
<td>guineesine, piperine, pipericide, piperlongumine, methyl piperate</td>
<td>Cough and cold</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Piper nigrum</strong> L. Piperaceae</td>
<td>Seed, Root</td>
<td>piperine, sylvamide, cepharadione A, piperoctalactam D, paprazine</td>
<td>To treat cut and wounds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Premna serratifolia</strong> Lamiaceae</td>
<td>Roots</td>
<td>Premnine, ganiarine, ganikarine</td>
<td>Laxative, stomach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pteridium aquilinum</strong> (L)Kuhn.v.Deck Pteridiaceae</td>
<td>Rhizome</td>
<td>Kaempferol</td>
<td>Astringent, chronic disorder, Anthelmintic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pteris cretica</strong> Linn. Pteridiaceae</td>
<td>Fronds</td>
<td>Luteolin</td>
<td>Antibacterial, Wounds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pygmaeoprmna herbacea</strong></td>
<td>Roots</td>
<td>Pygmaeocines A,B,C, Pygmaeoherin</td>
<td>Asthma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Name</td>
<td>Part Used</td>
<td>Active Ingredients</td>
<td>Medical Use</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
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<td>----------------------------------------------------------</td>
<td>--------------------------------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><em>Richardia scabra</em> <em>L.</em></td>
<td>Leaves</td>
<td>Emetin and starch</td>
<td>Skin diseases</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ruellia patula</em> <em>jacq.</em></td>
<td>Entire plant</td>
<td>Lignan glycoside, lyoniresinol, apigenin, β–sitosterol, lupeol,</td>
<td>Antidote for deadly poison Tiger spider</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Sansevieria roxburghiana</em> Schult.f. <em>Liliaceae</em></td>
<td>Entire plant</td>
<td>Sancevierine</td>
<td>Cough</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Sida rhombifolia</em> <em>L.</em> Malvaceae</td>
<td>Root</td>
<td>Ephedrine</td>
<td>Rheumatism</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Solanum torvum</em> <em>Solanaceae</em></td>
<td>Fruits</td>
<td>Sitosterol–D–glucoside, solasonine, steroidal sapogenin</td>
<td>Diabetics</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Spilanthes calva</em> <em>Asteraceae</em></td>
<td>Flowers</td>
<td>Spilanathol</td>
<td>Throat infections</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Spondias pinnata</em> Anacardiaceae</td>
<td>Fruits</td>
<td>B–amyryns, oleanolic acid</td>
<td>Diarrhea, dysentery</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Stenochlaena palustris</em> (Burm.f.)Bedd. Blechnaceae</td>
<td>Fronds</td>
<td>O–acylated flavonol glycosides, stenopalustrosides A–E</td>
<td>Throat and gastric ulcers</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tabernaemontana heyneana</em> Wall. Apocynaceae</td>
<td>Leaves, latex</td>
<td>Tabermoxidine, coronaridine, voacangine, iboganine</td>
<td>To induce abortion</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tacca leontopetaloides</em> Dioscoreaceae</td>
<td>Corm</td>
<td>Taccalin</td>
<td>Piles</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tagetes erecta</em> <em>Compositae</em></td>
<td>Leaves</td>
<td>Kaempferol–7–O–rhamnoside</td>
<td>Renal troubles, muscular pains</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Terminalia bellirica</em> (Gaertn) <em>Roxb.</em> Combretaceae</td>
<td>Fruit</td>
<td>β–sitosterol,gallic acid,mannitol,ellagic acid,ethyl gallate</td>
<td>Piles, rheumatism, leprosy</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tridax procumbens</em> L., <em>Asteraceae</em></td>
<td>Leaves</td>
<td>Lipids, β–amyrin, fucosterol, lupeol, sitosterol, lutolin, palmitic, stearic acids,etc</td>
<td>To cure swellings</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Tylophora indica</em> merr., <em>Asclepiadaceae</em></td>
<td>Leaf</td>
<td>Tylophorin, tylophorinine, Tylophorindine</td>
<td>Emetic, expectorant</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ventilago maderaspatana</em> Gaertn <em>Rhamnaceae</em></td>
<td>Stem, leaves, Root</td>
<td>Emadin</td>
<td>Pain reliever</td>
<td>37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Recently it has been reported that *croton coudatus* (Euphorbiaceae) is used as anticancer from Churachandpur district, Manipur\(^47\). Sandipan Das *et al* have reported 57 medicinal plants belonging to 45 genera and 36 families and their uses\(^48\). The aqueous leaf extract of the plant *Acanthus ilicifolius* can be substantially effective in preventing hepatic DNA alterations and sister–chromatid exchanges (a type of chromosomal damage) in tumor–bearing mice\(^49\). Antidiarrhoeal activity of five plants *viz.*, *Caesalpinia sepiaria, Dioscorea pentaphylla, Launaea pinnatifida, Syzygium rubicundum* and *Ziziphus jujuba* has been reported by P. Tetali and co–workers\(^50\). *Gymnema montanum* Hook (Asclepiadaceae), an endemic plant species of India, was used in protecting diabetes and its complications\(^51\). Effect on hyperglycemia, hyperlipidemia and augmented oxidative stress in experimental type 2 diabetes of *Diospyros peregrina* fruit has been reported\(^52\). *Caesalpinia bonducella* possesses potential immunomodulatory activity and has therapeutic potential for the prevention of autoimmune diseases\(^53\). The safety and efficacy of lemon juice and lemon grass (*Cymbopogon citratus*) in the
treatment of oral thrush in HIV/AIDS patients has been studied by S.C. Wright, J.E. Maree and M. Sibanyoni 54.

2.2 Past work on Pharmacognosy of medicinal plants

TLC and HPTLC profiles with other physio-chemical parameters, and phytochemical analysis of five medicinal plants used in Indian systems of medicine, have been reported by Rajbir Singh et al55. *Streblus asper* Lour. known as Shakhotaka in Ayurveda and Piraayan in Siddha, its taxonomical, pharmacognosical, physicochemical details and pharmacopoeial parameters have been studied by Madhavan and coworkers 56. *Acrotrema arnottianum* Wight known as Nilampunna is an herbaceous plant endemic to peninsular India and is distributed in Ghats of Kerala and Tamil Nadu. Phytochemical investigation, antibacterial and antioxidant activities of this plant have been reported by Usha Kumari et al 57. Pharmacognostic study and biological activity of *Cordia rothii* Roem. and Schult. (Boraginaceae) bark has been reported by Chauhan and Chavan 58. Pharmacognostical studies on the leaf of *Annona squamosa* Linn, known as sitaphala, custard Apple has been studied by Abhishek and Namrata 59. Comparative pharmacognosy of the two plants Meda and Mahameda, (*Polygonatum verticiilatum* (L.) Alt., *Polygonatum cirrifolium* (Wall.) Royle), and commercial sample have been analyzed by Rath Chinmay et al 60.

Both macro and microscopic markers from genuine fruits of *Piper nigrum* Linn. and its adulterants *Carica papaya* Linn., *Lantana camara* Linn. and *Embelia sribes* Burm. have been studied by S.C. Jain et al 60. Microscopical studies on the leaves of *Momordica Charantia* has been reported 61. Scientific validation and authentication of genuine and market samples of *Tinospora cordifolia* (Willd.) Miers ex Hook. F.& Thomas), known as Amrita in Ayurvedic system of medicine has been made 62.
made. Pharmacognostical and phytochemical evaluation of rare and endangered Habenaria intermedia D.Don., and Habenaria edgeworthii Hook.f, known as riddhi and vriddhi in Ayurveda have been reported. Srivastava and coworkers have reported the pharmacognostic evaluation of the rhizome Curcuma aromatic. Macroscopical, microscopical and quantitative evaluation of the leaves of Terminalia macroptera has been reported. Rivera–Arce’ and co workers have reported the pharmacognostical studies of the plant drug Mimosae tenuiflorae cortex. The comprehensive review of the genus Potentilla of the family Rosaceae provides a botanical description, phytochemical constituents in the aerial and underground parts, in vitro and in vivo pharmacological studies have been reported. The morphological, phytochemical and ethnopharmacological aspects of Humulus lupulus (hops), has been reviewed.

2.3 Medicinal importance of stephania

The genus Stephania, belonging to the Menispermaceae family, comprises about 60 species distributed mainly in Africa, India, South–East Asia and the northern and eastern parts of Australia. In these countries, the Stephania species feature prominently in the traditional medicine of the native peoples. More than 150 alkaloids have been isolated from plants of the Stephania genus and some show important biological activities such as antitumor activity and emetine type activity. Stephania abyssinica is a creeping plant, native to southern and eastern Africa, which has been reported to have use as a purgative and emetic. The roots are used in the treatment of roundworm, menorrhagia and boils. The aboriginal people of central Queensland and the Cape York region are using the tuber of Stephania bancroftii to form a poultice that is applied to wounds and joints as an anti–inflammatory agent, and the crushed leaves are used as a fish poison. Stephania glabra is a glabrous dexterous climber indigenous to the lower
Himalayas (5000 – 6000ft) of India. Extracts of the rhizomes of the plant have long been used by the natives as an antidysenteric, antipyretic and antiasthmatic. Some of the alkaloids isolated from the rhizomes of this plant possess hypotensive and antimicrobial properties. *Stephania longa* Lour. is a perennial herbaceous liana, and both its roots and the whole plants are applied in traditional Chinese Medicine to treat fever, inflammation, and dysentery. *Stephania pierrii* Diels (Synonym: *Stephania erecta* Craib) is a slender, herbaceous climber with large tubers and round leaves. The tubers are used in Thai folk medicine as a skeletal muscle relaxant and also as an analgesic and tonic under the name “Bua Bok”.

*Stephania rotunda* is a climber indigenous to India and Indochina. It has been used as a folk medicine for the treatment of pulmonary consumption, dysentery, fever, abdominal ills, asthma, ascariasis, dysmenorrheal, indigestion, wounds, head-ache, sore breasts, and leprosy. *Stephania sinica* Diels which is distributed in China is used as an analgesic and sedative, tranquilizer. *Stephania suberosa* Forman, native to Thailand, is commonly used in that country for the treatment of a variety of ailments under the local name ‘borapet pungchang’, is used in native medicine as a tonic, carminative, and expectorant. *Stephania sutchuenensis* H.S.Lo. is indigenous to the Sichuan Province of China. The roots are used in folkloric medicine for the treatment of common colds, sore throats and arthritic pain.

The traditional Chinese medicine “fen–fang–ji” the root of *Stephania tetrandra* S. Moore has been used as an analgesic, diuretic, and detumescent for thousands of years in China. The vine *Stephania venosa* Spreng. is commonly known in Thailand under the name of “Sabu–lead” or blood–soap, due to the red colour of its latex, and it is often used as a bitter tonic. *Stephania wightii* known as kollankovai, akasakkurudan (Tamil)
is used by the kanikars, one of the traditional healers of South India as analgesic, anti-inflammatory, anti-dysenteric and antipyretic. It is also used as anthelmintic and emetic.

2.4 Medicinal importance of *Flueggea*

Members of the genus were formerly labeled under the genus *Securinega*. *Pharaceumsuffruticosum* (or), *flueggea ramiflora* (Aiton.) Muell. (or) *Xylophylla ramiflora* one of the spices of genus *flueggea* of Phyllanthaceae family is used widely in Chinese medicine. It is used in the treatment of contusions and nervous paralysis. A medicinal drink made from the rasped bark of *Flueggea flexuosa* is used to treat fever in the Solomon Islands. *Flueggea virosa* is a low branching, dioeciously shrub, or a small tree, distributed throughout Tropical Africa. The decoction of the leaves and roots is used for abdominal pain in Tanzania while the leave decoction is drunk for fever by the Yorubas of South western Nigeria. The decoction of the leaves with other herbs is used in Northern Nigeria for treatment of painful swellings. *Flueggea leucopyrus*, Willd. Phyllanthaceae, (Local name: Mulluppulatti) leaves are used as vermifuge. It is also used to cure uterine polyp. The juice of the leaves is used to destroy maggots in sores

2.5 Medicinal importance of *Flacourtia*

*Flacourtia jangomas*,  *Flacouriaceae* (Coffee Plum family) Synonyms: *Stigmarota jangomas*,*Flacourtia cataphrata* the fruits and leaves are used against diarrhea. Dried leaves are used for Bronchitis and roots are used against toothache. *Flacourtia indica* (Burm. f.) Merr. (Synonymous: *Flacourtia ramontchi* L’Herit.) commonly known as ‘Baichi’ or ‘Katai’, is an indigenous medicinal plant widely distributed in Bangladesh and India. This plant has been reported as an effective remedy for the treatment of a variety of diseases. Fruits are used as appetizing and digestive, diuretic, in jaundice and enlarged spleen. Barks are used for the treatment of intermittent
fever. Roots are used in nephritic colic and gum is used in cholera. In the Deccan, the seeds are ground to powder with turmeric and rubbed all over the mother's body to prevent rheumatic pains owing to exposure after the birth of a child. The bark is applied to the body, along with the bark of *Albizia*, intervals of a day or so during intermittent fevers. *Flacourtia sepiaria*, Roxb. known as locally Kodumundi its leaves are used both internally and externally. It is used in the treatment of Liver disorder and rheumatism.

2.6 Medicinal uses of *Ventilago*

The bark, young shoots, root bark, fruits, seeds, and whole plant of *Ventilago denticulatea* willd. are medicinally useful. The juice of the bark is used to cure malarial fever and the juice of bark and young shoots applied all over body for body ache and generalized pain. The powder of root bark of *Ventilago maderaspatana* is useful as carminative, stomachic, stimulant, and given in tonic dyspepsia, debility and in mild fevers. Kanikars use the bark powder mixed with gingelly oil to cure skin diseases.

2.7 Past work on the medicinal plants of present investigation

In the present investigation, *Flacourtia indica* (Flacouriaceae), *Flueggea leucopyrus* (Phyllanthaceae), *Stephania wightii* Dunn. (Menispermaceae), and *Ventilago maderaspatana* Gaertn (Rhamnaceae) have been subjected to pharmacognosy. Recent literature survey indicates that the antimicrobial activity of *Flueggea leucopyrus* and *Ventilago maderaspatana* has been reported. Emodin a phytochemical is obtained from *Ventilago maderaspatana*. Trace element analysis of fruits of *Flacourtia indica* has been reported. However there is no other pharmacognostic information has been available for these plants. Pharmacognosy of *Stephania wightii* Dunn has not been reported.
2.8 Medicinal importance of the selected plants

*Stephania wightii* Dunn. (Menispermaceae) traditionally known as kollankovai, akasakkurudan (Tamil), have been used as an analgesic, anti-inflammatory, anti-dysenteric and antipyretic, by south indians especially kanikars. Moreover, it is also used as emetic and anthelmintic to treat nausea and drowsiness.

*Flueggea leucopyrus*, Willd. (Phyllanthaceae), (Local name: Mulluppulatti) quite oftenly used to cure uteine polyp. The juice of the leaves is used as a drug to inhibit intestinal worms (vemifuge) and to destroy maggots in stores.

*Flacourtia indica* (Burm. f.) Merr. (Flacourtiaceae) is an indigenous medicinal plant widely distributed in Bangladesh and India, commonly known as ‘Baichi’ or ‘Katai’. Different parts of this plant has been used to treat variety of diseases. For instance, fruits are used as an appetizer and diuretic, an effective remedy for jaundice and enlarged spleen. In the Deccan, the seeds are ground to powder with turmeric and rubbed all over the mother's body to prevent rheumatic pains owing to exposure after the birth of a child. Barks, roots and gum are used for the treatment of intermittent fever, nephritic colic and cholera, respectively. The bark of this plant were made into paste and applied to the body, along with the bark of *Albizzia*, at intervals of a day, during intermittent fevers.

The powder of root bark of *Ventilago maderaspatana* Gaertn. (Rhamnaceae) is useful as carminative, stomachic, stimulant, and given in tonic dyspepsia, debility and in mild fevers. Kanikars use the bark powder mixed with gingelly oil to cure skin diseases.
3. Scope of the Present Work

In order to remove the confusion, misidentification and adulteration of medicinal plants, it is important to give the details of anatomy of different parts used, chemical composition and fixing the identity of plant source. A systematic survey of literature reveals that no such pharmacognostic studies have been performed for *Flacourtia indica* (Flacouriactae), *Flueggea leucopyrus* (Phyllanthaceae), *Stephania wightii* Dunn. (Menispermaceae), and *Ventilago maderaspatana* Gaertn. (Rhamnaceae). Hence the objective of the present investigation is to perform systematic pharmacognostical determinations such as: Synonym and regional names and distribution, anatomical studies of the fresh root, stem and leaf, fluorescence analyses, total ash, acid–insoluble ash, water–soluble ash and extractive values of *Flacourtia indica* (Flacouriactae), *Flueggea leucopyrus* (Phyllanthaceae), *Stephania wightii* Dunn. (Menispermaceae) and *Ventilago maderaspatana* Gaertn. (Rhamnaceae).
4. Materials and Methods

4.1 Collection of specimens

The fresh medicinal plants had chosen for this research namely *Flacourtia indica* (Flacourtiaceae), *Flueggea leucopyrus* (Phyllanthaceae), *Stephania wightii* Dunn. (Menispermaceae) and *Ventilago maderaspatana* Gaertn. (Rhamnaceae), were collected from Agasthia hills, Tirunelveli district, Tamilnadu, India. The plants were identified by Dr. V. Chelladurai, Research Officer (Botany), Retired, Survey of Medicinal and Aromatic plants Unit– Siddha, CCRAS, Palayamkottai, Tirunelveli District, TamilNadu, India and specimens were deposited at Department of Chemistry, Sri Paramakalyani College, Alwarkurichi. Care was taken to select healthy plants and normal organs. The required samples of different organs were cut and removed from the plant and fixed in FAA. After 24 hours of fixing, the specimens were dehydrated with graded series of tertiary butyl alcohol as per the schedule given by Sass. Infiltration of the specimens was carried by gradual addition of paraffin wax (melting point 58 – 60°C) until tertiary butyl alcohol solution attained super saturation. The specimens were cast into paraffin blocks.

4.2 Sectioning

The paraffin embedded specimens were sectioned with the help of Rotary Microtome. The thickness of the sections was 10 – 12µm. Dewaxing of the sections was by customary procedure. The sections were stained with Toluidine blue as per the method published by O’Brien et al. Since Toluidine blue is a polychromatic stain, the staining results were remarkably good; and some cytochemical reactions were also obtained. The dye rendered pink colour to the cellulose walls, blue to the protein bodies etc. wherever necessary sections also stained with safranin and Fast – green and Iodine KI (for Starch).
For studying the stomatal morphology, venation pattern and trichome distribution, paradermal sections (sections taken parallel to the surface of leaf) as well as clearing of leaf with 5 % sodium hydroxide or epidermal peeling by partial maceration employing Jeffrey’s maceration fluid were prepared. Glycerin mounted temporary preparations were made for macerated/cleared materials. Powdered materials of different parts were cleared with sodium hydroxide and mounted in glycerin medium after staining. Different cell components were studied and measured.

4.3 Photomicrographs

Microscopic descriptions of tissues were supplemented with micrographs wherever necessary. Photographs of different magnifications were taken with Nikon Labphoto 2 microscopic unit. For normal observations bright field was used. For the study of crystals, starch grains and lignified cells, polarized light was employed. Since these structures have birefringent property, under polarized light they appear bright against dark background. Magnifications of the figures are indicated by the scale – bars. Descriptive terms of the anatomical features are as given in the standard Anatomy books.

4.4 Fluorescence analysis

The powders of the aerial parts and the tuber parts of the various medicinal plants studied in the present investigation and their extracts in various solvents were examined under ordinary light and UV light (254 nm and 365 nm). These powders were also treated with 1N NaOH (aqueous), 1N NaOH (ethanolic), 1N HCl, 1:1 H₂SO₄ and 1:1 HNO₃ and changes were recorded. These fluorescence characters were determined according to the methods of Chase and Pratt. The results are presented in Tables 2–5.
4.5 Quantitative determination

Total ash, acid-insoluble ash and water-soluble ash were obtained by employing standard method of analysis described in Pharmacopoeia of India. The results are presented in Tables 6 – 9.

4.6 Determination of total ash

Exactly 3g of air-dried powdered sample was taken in a previously weighed nickel crucible and ignited carefully, not exceeding dull red heat until the ash was free from carbon. The crucible was cooled and weighed. The percentage of ash with reference to the air-dried sample was calculated. The percentage of total ash value for various samples is presented in Tables 6 – 9.

4.7 Determination of acid–insoluble ash

Accurately 200mg weight of ash was boiled with 25ml of 4N hydrochloric acid. The insoluble matter was collected in a previously weighed sintered crucible washed with hot water, dried to constant weight and weighed. The percentage of acid–insoluble ash with reference to the air–dried sample was calculated. The percentage of acid–insoluble ash determined for various samples are presented in Tables 6 – 9.

4.8 Determination of water-soluble ash

Precisely 200mg weight of ash was boiled with 25 ml of distilled water. The insoluble matter was collected in a previously weighted sintered crucible washed with hot water, dried to constant weight and weighed. The percentage of water – soluble ash with reference to the air dried sample was calculated. The percentage of water soluble ash determined for various samples are presented in Tables 6 – 9.
4.9 Determination of extractive values

The extractive values of aerial parts of the different medicinal plants subjected to the present investigation in petroleum ether (40° – 60°C), benzene, chloroform, ethanol and water were determined by employing the methods of analysis described in Pharmacopoeia of India\textsuperscript{87}.

Exactly 5 g of air–dried sample was taken in a stopper flask. 100ml of the solvent was added, shaken well, and allowed to stand for 24 hour with occasional shaking. Then the content was filtered. 50ml of the filtrate was pipetted out into a clean, previously weighed china dish and evaporated on a water bath. Finally it was dried at 105 °C, cooled and weighed. The percentage of solvent soluble extractive with reference to the air–dried sample was calculated. The percentage of extractive value in various solvents is presented in Table 6 –9.
5. Result and Discussion

5.1 Taxonomic details of *Flueggea leucopyrus* Willd. Mull. Arg.

- **Family**: Phyllanthaceae
- **Genus**: *Flueggea*
- **Botanical name**: *Flueggea leucopyrus* (Willd.) Mull. Arg.
- **Vernacular name**: Mulluppulatti

5.1.1 Macroscopic characters

It is unarmed shrub with smooth rusty reddish–brown bark. Leaves are obovate, emarginated. White or greenish yellow scented in axillaries clusters. Drupe is globose, and white. It is a large, rigid, thorny bush plant with somewhat straggling branches, usually ending in sharp thorns. Leaves are simple, alternate, obovate reticulately veined beneath. Flowers are very small, male greenish yellow in clusters, and female reddish, also in clusters. Fruits are globose, with white fleshy berries.

The plant is sweet, cooling, diuretic, aphrodisiac and tonic, and is useful in vitiated conditions of pitta, burning sensation, strangury, seminal weakness and general debility. The leaves act as a disinfectant and its paste is used by tribes to extract any extraneous materials from body tissues without surgery. Microscopic studies of *Flueggea leucopyrus* (Willd.) Mull. Arg are follows.

**Microscopic Characters**

5.1.2 Leaf

The leaf is distinctly dorsiventral with prominent midrib and bilaterally symmetrical lamina (Fig.4). The midrib is slightly raised on the abaxial side and semicircular on the abaxial side. It is 280µm thick in vertical plane. The epidermal layers of the midrib consist of small, squarish, thick walled cells. A single prominent vascular strand is placed in the centre of midrib which is supported adaxially and
abaxially by compact, thick walled, hyaline parenchymatous ground tissue (Fig 4). The vascular bundle has about radial, short rows of thick walled wide and circular xylem elements and a narrow arc of phloem strands (Fig. 5). The vascular strand is 70 x100µm in size.

The lateral veins also have prominent vascular strand. They do not project much beyond the level of the lamina (Fig.6). The vascular strand has a conical segment of thick walled, compact, wide xylem elements and an arc of phloem. The vascular strand has a pad of abaxial parenchyma and adaxial vertical pillar of parenchyma (Fig.6)

5.1.3 Lamina

The lamina is 150µm thick. It has much dilated, circular or squarish adaxial epidermal cells; some of the cells are having dense mucilage contents. The epidermal cells are 25µm thick. The abaxial epidermis has large papillate cells which are 20µm thick. The mesophyll tissue is differentiated adaxial zone of darse, darkly staining, two or three layers of palisade cells, a median row of dilated, angular hyaline parenchyma cells and an abaxial zone of small, lobed mostly vertically oriented spongy parenchyma. There is another layer of dilated hyaline parenchyma cells just above the abaxial epidermis (Fig. 7).

The leaf margin is blunt and thick; it is slightly curved abaxially. It is as thick as the midportion of the lamina. The internal structure is similar to the midpart (Fig.8).

5.1.4 Petiole

The petiole is shield shaped in sectional view with shallow adaxial concavity and two short, thick lateral wings. The petiole is 1mm both horizontally and vertically. The wings are 200µm thick. The petiole has a narrow, but distinct layer of epidermis with
circular, thick walled cells. The ground tissue consists of dilated, compact fairly thick walled parenchyma cells. The cells contain large calcium oxalate druses; each cell has single druses filling the entire cell lumen (Fig 10). The druses are 30µm diameter. The druses are also seen in abundance in the mesophyll tissue (Figs.4 – 6)

The vascular strand is single prominent and semicircular. It has a several, parallel rows of xylem elements and an arch of phloem (Fig.9).

5.1.5 Stem

Both young and fairly old stems are studied. The young stem measuring 2.5 mm thick has smooth and even surface and circular outline. A thin layer of intact epidermis with rectangular cells is seen all around the stem. Two layers of sub epidermal cells have elongated radially forming a wide zone of radially oblong cells. The phellogen is seen along the inner boundary of the elongated cortical cells (Figs. 11 and 12). The cortex is narrow comprising of three or four layers of parenchyma cells. The inner boundary of the cortex has a thick, discontinuous cylinder of sclerenchyma cells. Secondary phloem is wide and continuous (Fig. 12).

Secondary xylem cylinder is 400µm thick. It consists of long radial multiples of vessels, narrow xylem rays and xylem fibers (Fig. 12). The vessels are fairly wide and measure 15 – 25µm in diameter. They are thick walled and angular or circular in diameter. The xylem fibers thick walled and lignified and have wide lumen. The rays are straight and undilated; the ray cells are spindle shaped.

5.1.6 Old stem

In the old stem, the epidermis is broken at several places due to vigorous expansion of periderm. In the broken region, the phloem is exposed (Figs. 14 and 15).
**Flueggea leucopyrus Willd.**

(Macroscopic & Microscopic Character)

**Fig. 3** Morphology of *Flueggea leucopyrus*

**Fig. 4** T.S. of leaf through midrib with lamina

**Fig. 5** Midrib vascular bundle enlarged

**Fig. 6** T.S. of leaf through lateral vein

**Fig. 7** T.S. of lamina

**Fig. 8** T.S. of leaf margin

(Abs - Abaxial side; AdE - Adaxial epidermis; Ads - Adaxial side; Cr - Crystal; Cu - Cuticle; Ep - Epidermis; GT - Ground tissue; La - Lamina; PEP - Papillate epidermal; Ph - Phloem; PT - Palisade tissue; VB - Vascular bundle; X - Xylem; LM - Leaf margin; Mu - Mucilage; PM - Palisade mesophyll; SM - Spongy mesophyll)
Flueggea leucopyrus Willd.
(Microscopic Character)

Fig. 9 T.S. of petiole entire view

Fig. 10 T.S. of petiole showing crystals in the ground tissue (under polarized light microscope)

Fig. 11 T.S. of Stem half-portion enlarged

Fig. 12 T.S. of stem a sector enlarged

(Ads - Adaxial side; Cr - Crystal; Ep - Epidermis; GT - Ground tissue; Ph - phloem; W - Wing; X - Xylem; Co - Cortex; Epi - Epidermis; Pe - Periderm; Pi - Pith; Sc - Sclerenchyma; Sph - Secondary phloem, Sx - Secondary xylem; Ve - Vessel; Xpi - Xylem fibre)
**Flueggea leucopyrus Willd.**

*Microscopic Character*

*Fig. 13* T.S. of stem ground plan

*Fig. 14* T.S. of Stem a sector enlarged

*Fig. 15* T.S. of periderm

*Fig. 16* T.S. of Secondary xylem

*Fig. 17* T.S. of primary xylem and pith

(Pe - Periderm; Pi - Pith; Ve - Vessel; Sph - Secondary phloem;
XR - Xylem ray; Sx - Secondary xylem; XFi - Xylem fibre)
The phloem cells are in four or five layers; they are radially oblong and thick walled. A distinct phellogen and two layers of phelloderm are seen in the periderm.

Secondary xylem is increased in the radial width. It consists of heavily thick walled fibers arranged in regular radial rows; the lumen is fairly wide (Fig. 16). The xylem rays are one or two cell wide, straight and the ray cells are thick and lignified. The fibers at certain places are gelatinous type; they have inner gelatinous cellulose walls without lignin; they stain dark purple instead of blue with Toludine blue stain (Figs. 14 and 16). The vessels are in short and long radial multiples; they are angular or ovate, thick walled and wide (Fig. 17).

5.2 Taxonomic details of *Flacourtia indica*

- **Family**: Flacouriaceae
- **Genus**: Flacourtia
- **Botanical name**: Flacourtia indica (Burm. f.) Merr
- **Vernacular name**: cholhakilai, kutukali, mulanninchil, sottaikala

### 5.2.1 Macroscopic characters

These are small trees which are 2–4 m tall, deciduous and bark is gray–yellow coloured, fissured, and flaky. Old branches are not usually spiny. Young branches are with axillary and simple spines. Branchlets are puberulous. Petiole is red, short, 3–5 mm, and puberulous; leaf blade is greenish abaxially and deep green adaxially, rose red when young, obovate to oblong–obovate, thickly papery, abaxially glabrous, hairs are spreading and short, adaxially glabrous, mid–vein raised abaxially, flat adaxially. Lateral veins 5–7 pairs, reticulate veins conspicuous, base mostly acute to obtuse, margin serrulate above middle, apex rounded, sometimes retuse. Pedicels are 3–5 mm, puberulous, hairs spreading. Sepals are 5 or 6, ovate, outside glabrous or with a few scattered short hairs, inside sparsely to densely pubescent, margin white ciliate in dried
material, apex obtuse. Staminate flowers: stamen filaments 2–2.5 mm, pubescent or less often glabrous. Pistillate flowers are ovary globose, placentas 5 or 6; styles 5 or 6, united only at base, radiating, 1–2 mm, slender. Fruit is dull to blackish red, globose, Seeds are 5 or 6.

**Microscopic Characters**

**5.2.2 Leaf**

Basal part: The leaf has prominent midrib which has adaxial concavity with a central wide and shallow ridge and two lateral wings like lamina (Fig19). The midrib is 450µm both in vertical and horizontal planes. It has a distinct epidermal larger of squarish cells with thick tuberculcute cuticular layer (Fig.20). The ground parenchyma has circular compact, thick walled cells. The vascular strand is slightly concave with thick horizontal leaves of xylem elements, wide zone of phloem and thick sheath of sclerenchyma cells (Fig.21).

**5.2.3 Midrib**

The mid– part of the leaf, the vascular bundle of the midrib is top–shaped and prominent. It has a triangular mass of xylem elements and a prominent are of phloem elements. A thick arc of sclerenchyma occurs both at basal and upper portions of the vascular bundle (Fig 20).

**5.2.4 Lamina**

The lamina has smooth and even surfaces. It is 160µm thick. The leaf margin is widely semicircular and is 100µm thick. The leaf has thick and smooth cuticle which is 5 or 7µm thick. The epidermal cells are squarish or rectangular measuring 10µm thick. The mesophyll tissue is not differentiated into palisade ad spongy parenchyma tissues.
The mesophyll consists of about six layers of vertical columnar palisade cells. The upper palisades are 40µm in height and lower palisade cells are 20µm in height. The vascular bundles of the lateral veins are prominent due to the presence of highly thick bundles of sclerenchyma cells on the upper and lower ends of the bundles (Figs. 21, 22 and 23).

5.2.5 Venation

In paradermal sections the venation pattern and stomatal morphology are studied. The lateral veins and veinlets are thick and straight. They form well defined vein–islets of various shapes and size and of random orientation. The vein terminations are short, thick and straight (Fig. 24).

5.2.6 Stomata

The stomata occur on the lower epidermis; they are deeply sunken in the epidermal layer. The stomata are of paracytic type; two parallel distinct subsidiary cells are evident for each stoma. The epidermal cells are narrow, polygonal and thin walled (Fig. 25).

5.2.7 Petiole

The petiole is semicircular with adaxial shallow concavity. It is 550µm vertically and 700µm horizontally. It has a narrow epidermal layer of small thick walled cells. The ground tissue has circular thick walled parenchyma cells. The vascular strand is arc shaped and collateral. It is 120µm thick and 350µm wide. The vascular arc has compact parallel lines of thick walled angular xylem elements, a wide band of phloem and a prominent sheath of sclerenchyma cells (Figs. 26 and 27)
**Flacourtia indica (Burm.f.) Merr.**

(Macroscopic & Microscopic Character)

*Fig. 18* Morphology of *Flacourtia indica*  *Fig. 19* T.S. of leaf through midrib with lamina

*Fig. 20* T.S. of midrib - magnified 10x

*Fig. 21* T.S. of lamina showing crystals in the mesophyll tissue

(AbE - Abaxial epidermis; Abs - Abaxial side; AdE - Adaxial epidermis; Ads - Adaxial side; Cr - Crystal; Cu - Cuticle; Ep - Epidermis; Gp - Ground parenchyma; La - Lamina; LPM - Lower palisade mesophyll; LV - Lateral vein; MR - Midrib; Ph - Phloem; Sc - Sclerenchyma; VPM - Upper palisade mesophyll; X - Xylem; VB - Vascular bundle; PM - Palisade mesophyll)
Flacourtia indica (Burm.f.) Merr.

(Microscopic Character)

Fig. 22 T.S. of Leaf margin

Fig. 23 T.S. of lamina

Fig. 24 Paradermal section showing vein-islets and vein-termination

Fig. 25 Abaxial epidermis with stomata

Fig. 26 T.S. of petiole ground plan

Fig. 27 T.S. of petiole a sector enlarged

(Cu - Cuticle; Ep - Epidermis; LpM - Lower palisade mesophyll; LV - Lateral vein; PM - Palisade mesophyll; SC - Sclerenchyma; VB - Vascular bundle; EC - Epidermal Cell; Sc - Subsidiary cells; St - Stoma; VI - Vein-islets; VT - Vein-termination; Ads - Adaxial side; GP - Ground parenchyma; GT - Ground tissue; Ph - phloem, X - Xylem)
**Flacourtia indica (Burm.f.) Merr.**

(Microscopic Character)

**Fig. 28** Crystals in the mesophyll tissue

**Fig. 29** Crystals in the ground tissue of petiole

**Fig. 30** Crystals enlarged

**Fig. 31** T.S. of stem a sector enlarged

**Fig. 32** T.S. of stem showing epidermis and cortical tissue

**Fig. 33** T.S. of stem showing secondary xylem

**Note:** Figs. 28, 29 & 30 - Crystal distribution in the leaf (Under polarized light microscope)

(Cr - Crystal; Ep - Epidermis; GT - Ground tissue; Ph - Phloem; X - Xylem; Co - Cortex; Pe - Periderm; Pi - Pith; Sph - Secondary phloem; Sx - Secondary xylem)
5.2.8 Occurrence of crystals

Calcium oxalate crystals are abundant in the leaf and petiole. In the leaf, they occur as prismatic type along the veins (Fig.28). They are 10–15 µm in length. In the ground cells of the petiole, the crystals are mostly druses. They occur in the phloem zone or ground parenchyma (Figs.29 and 30). The druses are up to 20µm in size.

5.2.9 Stem

The stem is circular in cross sectional view. It has smooth surface. It consists of periderm, cortex, cortical sclerenchyma, secondary phloem, secondary xylem and pith (Fig.31). The periderm is 40µm thick including the epidermal layer of darkly staining spindle shaped cells. The periderm has wide, thin walled phloem cells outside. Cortex is about six layers in thickness. The cells are wide, tangential oblong and rectangular and compact.

Anatomy of the stem

Sclerenchyma: Inner to the cortex is a thin, less prominent sclerenchyma layer. It is adjacent both phloem zone.

Secondary phloem: It is narrow and continuous. It consists of sieve elements and parenchyma cells. The secondary phloem elements are in regular radial files (Fig.32).

Secondary xylem: It is a dense hollow cylinder comprising of vessels and fibers. The vessels are angular, wide, thin walled and solitary; they are diffuse in distribution. They are 20µm wide. The xylem fibers are fairly thick walled and lignified. The fiber lumen is wide. Both the vessels and fibers are in radial forms (Fig. 33).
5.3 Taxonomic details of *Stephania wightii* Dunn

- **Family**: Menispermaceae
- **Genus**: *Stephania*
- **Botanical name**: *Stephania wightii* Dunn
- **Vernacular name**: Akasakarudan, kollankovai

5.3.1 Macroscopic characters

The plant is a twiner, growing on the thickets and bushes. The leaves are cordate, chartaceous, glabrous and leaves broadly rounded; Flowers: unisexual; Male flowers in umbels, perianth – tetramerous; sepals – 4; petals – 4, greenish, stamens 6–8; peltate gynandrium; anthers dehisce transversely; Female flowers Sepals: 3–5, oblong; petals 3–5, sub orbicular; ovary 6–9 carpels, apocarpous, two ovules in each carpel; Fruits – drupe.

Microscopic Characters

5.3.2 Leaf

The leaf is distinctly dorsiventral with prominent adaxial midrib and bilateral symmetry of the lamina. The midrib has convex adaxial part and prominent semicircular abaxial part. It is 400µm vertically and 450µm horizontally. The adaxial epidermis of the midrib has prominently papillate cells which are nearly 20µm thick (Figs.35 and 36). Beneath the adaxial epidermis is narrow band of about four layers of collenchymas cells. The abaxial epidermis has comparatively thicker epidermal layer some of its cells being papillate (Fig.36). Above the epidermal layer are three or four layers of larger, thick walled compact parenchyma cells. There is a single, centrally placed vascular bundle which is embedded in a ass of small compact, thin walled parenchyma cells. The
vascular bundle has a cluster of wide, angular and thick walled xylem elements and horizontal band of phloem elements. The xylem elements are 20 – 25µm wide.

The lateral veins are not much projecting on the surface of the lamina (Fig.37). It has a central small vascular bundle surrounded by sclerenchyma cells; the bundle sheath extends both adaxially and abaxially forming a vertical girdle.

5.3.3 Lamina

The lamina is 200µm thick. Both adaxial and abaxial epidermal layers have prominent papillate epidermal cells which are to 10 – 20µm thick. The mesophyll consists of an abaxial bound of single row of cylindrical, wide spaced palisade cells which are 20µm in height. Spongy mesophyll is four layered; the cells are much lobed and attached with each other with their arm forming wide air – chambers. (Fig 38)

5.3.4 Epidermal cells and stomata

Abaxial epidermal cells are highly lobed and amoeboid in outline (Fig.39). The anticlinal walls are fairly thick. The cells have circular, darker outline in the centre which represents the papillae of the outer tangential walls of the epidermis (Fig35 and 36). The circular papillae have central darker line and outer paler halo (Fig 39). They papillae are 10µm in diameter and 10µm in height. Stomata occur only on the lower side of the leaf. They are a monocytic type and lacking distinct subsidiary cells (Fig.40). The guard cells are large and measure 25 x 30µm. The abaxial epidermal cells are larger and amoeboid in outline with thick anticline walls.

5.3.5 Petiole

Petiole is circular in transactional view; the outline is smooth and even. It is 850µm in diameter. It has a thin epidermal layer of small squarish cells. The outer zone
of ground tissue consists of slightly thick walled, radially oblong collenchymas cells (Figs. 41 – 43). The central ground tissue has polygonal, thin walled cells.

The vascular system consists of a ring of about eight discrete vascular bundles with wide intervals. The bundles are top shaped and collateral. The bundle has a wide mass of phloem elements and a cluster of wide, thick walled angular or circular elements (Fig. 44). The xylem elements are 15 – 20µm wide.

5.3.6 Root – Tuber

The root tuber is fleshy and parenchymatous with thick periderm and parenchymatous with thick periderm and reduced xylem and phloem. Periderm is wide, deeply fissured; the fissures are irregular. The periderm has outer zone of dead, suberised rectangular (tabular) phloem cells. The inner zone of the periderm has a narrow lean of phelloderm cells which are living rectangular, thin walled cells. Some of the phelloderm cells become sclereids (Figs. 45 and 46) Cortex is wide and parenchymatous. The cells are polygonal, thin walled and compact.

5.3.7 Vascular system

The central core of vascular system consists of several, narrow, radial bands xylem which are separated widely from each other by dilated ray – parenchyma. The xylem segments have narrow radial – multiples of vessels which are thin walled, angular and wid. At the outer end of each xylem segment, a narrow cone of phloem is seen. The dilated ray parenchyma cells have radially elongated, thin walled cells. These cells are storage in function. The rays extend from xylem (xylem ray) up to the phloem (phloem – rays).
Stephania wightii Dunn.

(Macroscopic & Microscopic Character)

Fig. 34 Morphology of Stephania wightii

Fig. 35 T.S. of leaf through midrib with lamina

Fig. 36 Midrib vascular bundle enlarged

Fig. 37 T.S. of lamina through lateral vein

Fig. 38 T.S. of lamina

(Abs - Abaxial side; Ads - Adaxial side; AbE - Abaxial epidermis; Col - Collenchyma; La - Lamina; PE - papillate epidermal cells; Ph - phloem; PM - Palisade mesophyll; LV - Lateral vein; SM - Spongy mesophyll; Cu - Cuticle; X - Xylem)
Stephania wightii Dunn.

(Microscopic Character)

Fig. 39 Adaxial epidermis

Fig. 40 Abaxial epidermis with stomata

Fig. 41 T.S. of petiole - proximal region

Fig. 42 T.S. of petiole - Distal region ground plan

Fig. 43 Epidermis and parenchymatous ground tissue

Fig. 44 One vascular bundle magnified

(Abs - Abaxial side; EC - Epidermal cells; P - papillate of the epidermal cell; St - stoma; Ep - Epidermis; GT - Ground tissue; LT - Leaf trace; VB - Vascular bundle; Col - Collenchyma; Ep - Epidermis; Ph - phloem; Pa - parenchyma; X - Xylem)
**Stephania wightii Dunn.**

*(Microscopic Character)*

**Fig. 45** T.S. of rhizome through periderm region

**Fig. 46** T.S. of rhizome cortical region

**Fig. 47** T.S. of rhizome inner vascular region

**Fig. 48** Crystals along the vein

**Fig. 49** Crystals enlarged

**Fig. 50** T.S. of rhizome showing crystals in the cortical tissue

*Note:* Figs. 48, 49 & 50 - Crystal distribution (under polarized light microscope)

(Co - Cortex; Pd - phellosderm; Pe - periderm; X - Xylem; Xe - Xylem parenchyma; Cr - Crystals; MT - Mesophyll tissue; Sc - Sclereids; V - Vein)
5.3.8 Crystal distribution

Calcium oxalate crystals are abundant in the leaf and tuber parts. In the leaf, the crystal type is styloid. They are narrow, elongated and scale-like in shape. They occur around the veins and are parallel to the long axis of the vein (Figs. 48 and 49). The styloids are 40µm long and 10µm thick. In the tuber, the crystals are druses. They are mostly associated with the sclereids (Fig.50). The druses are varying in shape and size.

5.4 Taxonomic details of Ventilago maderaspatana Gaertn

Family : Rhamnaceae
Genus : Ventilago
Botanical name : Ventilago maderaspatana Gaertn.
Vernacular name : Vempadampatchilai

5.4.1 Macroscopic characters

These plants are large woody climbing shrubs with drooping branches. Bark is grey with vertical cracks exposing the red surface. Leaves are elliptic to oblong, crenate-sersate. Flowers are greenish – yellow, in axillary and terminal panicles and Fruit is samaroid (Fig.51).

Microscopic Characters

5.4.2 Leaf

The leaf is dorsiventral, amplistomatic with prominent midrib and conspicuous lateral veins. The lamina has smooth and even surfaces (Fig.52). The adaxial epidermal layer has dilated, spherical or wide papillate cells (Fig.52). The adaxial epidermis is stomatiferous. The stomata have wide stomal chambers. The lamina is 170µm thick; the adaxial epidermis is 30µm wide. The abaxial epidermis is narrow and the cells are cylindrical or circular. The mesophyll tissue is differentiated into adaxial palisade zone and abaxial mesophyll. The palisade cells are single layered, wide and cylindrical.
measuring 50µm in height. The spongy mesophyll consists of four or five lobed cells interconnected forming wide air–chambers (Fig.53). The lateral vein does not project beyond the surface of the lamina (Fig.54). It has a small cluster of xylem elements and a group of phloem elements. It has adaxial and abaxial trans current parenchyma cells.

5.4.3 Midrib

The midrib is flat on the adaxial side and prominently projecting on the abaxial side in the form a wide semicircular body (Fig.55). It has distinct layer of cylindrical or circular epidermal cells, one or two layers of sub epidermal collenchymas cells, parenchymatous ground tissue and secretory canal with a distinct layer of epithelial cells (Fig.55). The vascular strand of the midrib consists of two groups of xylem elements. There is horizontal band of wide angular thick walled abaxial xylem and abaxial phloem; on the adaxial side is a larger group of similar type of xylem elements with its phloem (Fig.56). A narrow pillar of vertical trans current cells is seen along the adaxial epidermis and adaxial vascular strand. The midrib is 550µm in vertical plane and 500µm in horizontal plane.

5.4.4 Venation

The lateral veins are uniformly thick and straight. They form wide and distinct vein islets which regularly squarish or rectangular in outline. The vein terminations are present in most of islets. The terminators are either short and simple or fairly long and forked once (Fig.57).

5.4.5 Epidermal cells and stomata

The abaxial epidermal cells have thin wavy anticlinal walls, so that the epidermal cells appear amoeboid in out line. The stomata are amomocytic; the guard cells are fairly large thin walled with wide stomatal aperture (Fig.58). The adaxial epidermis has
cells with wavy or straight walls which are fairly thick, cuticular striations are seen in large lines which are closely running. The stomata are amioscytic type. The guard cells are elliptic and thick walled (Fig.59).

5.4.6 Petiole

The petiole is circular in sectional view and measures 1.2µm thick. The surface is smooth and even. It has narrow epidermal layer of radially rectangular cells with thick cuticle. The ground tissue is homogeneous with small compact thick walled parenchyma cells. The vascular strand is semicircular with shallow adaxial concavity. It is 470µm in horizontal axis and 300µm in vertical axis. It consists of dense radial files of elliptical thin walled xylem elements with isolated masses of phloem (Fig.61). The cells around the vascular strand have dense tannin colour.

Calcium oxalate crystals of prismatic type are fairly abundant in the ground tissue of the petiole. The prismatic type ranges from rhomboidal to cuboidal (Figs.62 and 63). The crystals in the ground parenchyma are layers and are 15 – 20µm. The crystals in the phloem parenchyma are minute and are less prominent.

5.4.7 Stem

Fairly thick stem measuring 2mm in diameter was studied. It is even along the surface. No periderm was evident. A narrow epidermis with small thick walled cells is seen along the surface. Wide cortex, thick hollow vascular cylinder and narrow pith are seen in the stem (Fig.64). The cortex is wide and it is 250µm in radial plane. It consists of a mixture of tannin filled parenchyma cells and dense masses of sclerenchyma cells with un lignified walls (Figs. 65 and 67). Secondary phloem is a narrow continuous zone around the xylem cylinder. Encircling the phloem is a thin, discontinuous cylinder fiber with lignified walls (Fig.65).
**Ventilago maderaspatana Garten.**

(Macroscopic & Microscopic Character)

*Fig.51* Morphology of Ventilago maderaspatana

*Fig.52* T.S. of lamina through lateral vein

*Fig.53* T.S. of lamina magnified

*Fig.54* Lamina with lateral vein enlarged

*Fig.55* T.S. of Leaf through midrib with lamina

*Fig.56* Midrib vascular bundle enlarged

(AbE - Abaxial epidermis; AdE - Adaxial epidermis; LV - Lateral vein; MT - Mesophyll tissue; Ph - Phloem; PH - Palisade mesophyll; SM - Spongy mesophyll; St - Stomata; TC - Transcurrent parenchyma cells; X - Xylem; Abph - Abaxial phloem; Abx - Abaxial xylem; Adph - Adaxial phloem; AdX - Adaxial xylem; Ep - Epidermis; GT - Ground tissue; La - Lamina; Mr - Midrib)
**Ventilago maderaspatana Garten.**

**(Microscopic Character)**

*Fig. 57* Vein-islets and Vein-termination

*Fig. 58* Abaxial epidermis with stomata

*Fig. 59* Stomata enlarged

*Fig. 60* T.S. of petiole entire view

*Fig. 61* T.S. of petiole half-portion enlarged

*Fig. 62* T.S. of petiole showing crystals in the ground tissue

*Fig. 63* Prismatic Crystals enlarged

(Ec - Epidermal Cell; Gc - Ground cell; Sc - Subsidiary Cell; St - Stomata; VI - vein-islets; VT - Vein-termination; Ads - Adaxial side; Ep - Epidermis; GT - Ground tissue; ph - phloem; Vs - Vascular strand; X - Xylem; Cr - Crystal; Pcr - Prismatic crystals)
*Ventilago maderaspatana* Garten.

(Microscopic Character)

*Fig.64* T.S. of stem entire view

*Fig.65* T.S. of stem a sector enlarged

*Fig.66* T.S. of stem showing secretory cavity in the pith region

*Fig.67* T.S. of stem - Cortical region

*Fig.68* T.S. of stem - Secondary xylem

(Co - Cortex; Pi - Pith; SC - Secretory cavity; Sph - Secondary phloem; Sx - Secondary xylem; Sc - Sclerenchyma; Ve - Vessel; XF - Xylemfibre; XR - Xylem ray)
Secondary xylem has diffusing distributed vessels. They are elliptical, wide and thin walled; the vessel aggregation may be solitary or in short radial multiples. The vessels are 40 – 50µm in diameter. The xylem fibers are thick-walled with wide lumen; the walls are lignified (Fig.68). The xylem rays are narrow and straight. Secretory cavities are often seen in the pith portion of the stem (Fig.65). The cavities are angular in sectional view with a diameter of 40 µm. The cavity is surrounded by dilated spindle shaped epithelial cells which strain deeply compared to the ground parenchyma. No content is evident within the cavity.

5.5 Comparative Microscopic Characters

5.5.1 Leaves

Leaves of Flueggea leucopyrus, Stephnia wightii, Ventilago maderaspatana are dorsiventral. Flueggea leucopyrus consist with midrib and bilaterally symmetric lamina. Flacourtia indica consists of midrib which has adaxial concavity and two lateral wing like lamina, Stephania wightii consists of adaxial midrib and bilateral symmetry of lamina and Ventilago maderaspatana is amplistomatic with prominent midrib and conspicuous lateral veins, the adaxial epidermis is stomatiferous and the lamina has smooth and even surfaces. Stomata occur on the lower epidermis and it is paracytic type in Flacourtia indica whereas stomata are anomocytic in both Stephnia wightii and Ventilago maderaspatana.

5.5.2 Veins and vein–islets

The mesophyl is divided into small portions by the branching and anastomosis of the veins throughout the tissue. The small areas of green tissue outlined by the veinlets are termed as vein–islets. The lateral veins of Flueggea leucopyrus and Stephnia wightii have prominent vascular strand and they do not project much beyond the level of lamina.
but in latter calcium oxalate crystals are abundant around vein and parallel to vein. In *Flacourtia indica* the veins and vein islets are thick and straight and form well defined vein–islets of various types, the vein terminations are short, thick and straight. In *Ventilago maderaspatana* wide and distinct veins islets are formed and the vein terminations are present in most of the cells.

### 5.5.3 Petiole

In *Flueggea leucopyrus* the petiole has a narrow, distinct layer of epidermis with circular cells which contains calcium oxalate druses. The petiole is semicircular with adaxial shallow concavity in *Flacourtia indica* and it has narrow epidermal layer of small thick walled parenchyma cells containing abundant calcium oxalate crystals. The petiole is circular in both *Stephania wightii* and *Ventilago maderaspatana* but the former has a thin epidermal layer of small squarish cells and the latter has narrow epidermal layer of radially rectangular cells with cuticle and calcium oxalate crystals of prismatic type is abundant in the ground tissue of the petiole.

### 5.5.4 Stem

A thin layer of epidermis with rectangular cells is present round the stem of *Flueggea leucopyrus* whereas a narrow epidermis with small thick walled cells is seen along the surface of the *Ventilago maderaspatana*. The cortex of *Flueggea leucopyrus* is narrow and contains three or four layers of parenchyma cells. In *Flacourtia indica* the cortex is about six layers thick and the cells are wide tangential oblong and rectangular. The cortex of *Ventilago maderaspatana* consists of mixture of tannin filled parenchyma cells and dense masses of sclerenchyma cells with undignified walls.
5.5.5 Root

The root tuber of *Stephania wightii* is fleshy and parenchymateous with thick periderm. Cortex is wide and parenchymateous. Calcium oxalate crystals are abundant and styloid type. These crystals are druses and are associated with sclereids.

5.6 Fluorescence analysis

The aerial part powder of the different plants and their extracts in various solvents were examined under ordinary light and also under ultra–violet light (254 nm and 365nm). These powders were also treated with various chemical reagents and the changes in colour are recorded in Tables 2–5.

5.7 Physico–chemical character

Physico–chemical constant is an important parameter in detecting adulteration on improper handling of drug. The important in the evaluation of crude drugs, is the ash value and acid insoluble ash value determination. The total ash content is designed to measure the total amount of residual matter remaining after ignition, particularly important in the evaluation of purity of drugs, the presence of or absence of foreign inorganic matter such as metallic salts or silica. Total ash value of *Stephania wightii* (8.94%) is maximum followed by *Ventilgo maderaspatana* (7.05%), *Flueggea leucopyrus* (5.71%) and minimum in *Flacourtia indica* (5.36%). The high ash value of *Stephania wightii* is due to the physiological as compared to the non – physiological ash. For herbal medicines with considerable levels of physiological ash, the acid insoluble ash content serves as another supplementary evidence to illustrate the quality of the plant material. The acid insoluble ash value of *Stephania wightii* is the lowest (2.56%) and it is somewhat higher in *Ventilago maderaspatana* (5.12%) and *Flacourtia indica* (15.44%) and highest in *Flueggea leucopyrus* (25.53%). The water soluble
ash is used to detect the presence of material exhausted by water. The water soluble ash value is highest in *Stephania wightii* and lowest in *Flacourtia indica*. Aqueous extractive values of aerial parts of *Flacourtia indica*, *Flueggea leucopyrus*, *Ventilgo maderaspatana* and tuber part of *Stephania wightii* show maximum values followed by ethanol, chloroform, benzene and petroleum ether extracts. The extractive value of *Flacourtia indica* is low, therefore large quantity of the crude drug is needed to be used to get the desired pharmacological effect.
Table. 2 Fluorescence characters of *Flacourtia indica*

<table>
<thead>
<tr>
<th>S.No</th>
<th>Treatments</th>
<th>Under ordinary light</th>
<th>Under UV light (254nm)</th>
<th>Under UV light (365nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Powder as such</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
</tr>
<tr>
<td>2</td>
<td>Powder + 1N NaOH (aqueous)</td>
<td>Dark red</td>
<td>Dark green</td>
<td>Dark brown</td>
</tr>
<tr>
<td>3</td>
<td>Powder +1N NaOH (ethanolic)</td>
<td>Yellow</td>
<td>Green</td>
<td>Sandal yellow</td>
</tr>
<tr>
<td>4</td>
<td>Powder + 1N HCl</td>
<td>Light green</td>
<td>Green</td>
<td>Light green</td>
</tr>
<tr>
<td>5</td>
<td>Powder + 1:1 H₂SO₄</td>
<td>Brown</td>
<td>Green</td>
<td>Light brown</td>
</tr>
<tr>
<td>6</td>
<td>Powder + 1:1 HNO₃</td>
<td>Red</td>
<td>Greenish yellow</td>
<td>Dark brown</td>
</tr>
</tbody>
</table>

Table. 3 Fluorescence characters of *Flueggea leucopyrous*

<table>
<thead>
<tr>
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<th>Treatments</th>
<th>Under ordinary light</th>
<th>Under UV light (254nm)</th>
<th>Under UV light (365nm)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Powder as such</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
</tr>
<tr>
<td>2</td>
<td>Powder + 1N NaOH (aqueous)</td>
<td>Reddish brown</td>
<td>Green</td>
<td>Brown</td>
</tr>
<tr>
<td>3</td>
<td>Powder +1N NaOH (ethanolic)</td>
<td>Black</td>
<td>Yellowish green</td>
<td>Reddish brown</td>
</tr>
<tr>
<td>4</td>
<td>Powder + 1N HCl</td>
<td>Brown</td>
<td>Light green</td>
<td>Light brown</td>
</tr>
<tr>
<td>5</td>
<td>Powder + 1:1 H₂SO₄</td>
<td>Black</td>
<td>Green</td>
<td>Brown</td>
</tr>
<tr>
<td>6</td>
<td>Powder + 1:1 HNO₃</td>
<td>Red</td>
<td>Green</td>
<td>Brown</td>
</tr>
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</table>
Table. 4 Fluorescence characters of *Ventilago maderaspatana*

<table>
<thead>
<tr>
<th>S.No</th>
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<th>Under UV light (254nm)</th>
<th>Under UV light (365nm)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Powder as such</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>2</td>
<td>Powder + 1N NaOH (aqueous)</td>
<td>Reddish brown</td>
<td>Green</td>
<td>Greenish yellow</td>
</tr>
<tr>
<td>3</td>
<td>Powder +1N NaOH (ethanolic)</td>
<td>Brown</td>
<td>Yellowish green</td>
<td>Yellow</td>
</tr>
<tr>
<td>4</td>
<td>Powder + 1N HCl</td>
<td>Light green</td>
<td>Dark green</td>
<td>Light brown</td>
</tr>
<tr>
<td>5</td>
<td>Powder + 1:1 H₂SO₄</td>
<td>Greenish yellow</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>6</td>
<td>Powder + 1:1 HNO₃</td>
<td>Brown</td>
<td>Dark green</td>
<td>Brown</td>
</tr>
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</table>

Table. 5 Fluorescence characters of *Stephania wightii* Dunn

<table>
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<th>S.No</th>
<th>Treatments</th>
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<th>Under UV light (254nm)</th>
<th>Under UV light (365nm)</th>
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<tr>
<td>1</td>
<td>Powder as such</td>
<td>brown</td>
<td>Light green</td>
<td>Light green</td>
</tr>
<tr>
<td>2</td>
<td>Powder + 1N NaOH (aqueous)</td>
<td>Brown</td>
<td>Light green</td>
<td>Light green</td>
</tr>
<tr>
<td>3</td>
<td>Powder + 1N NaOH (ethanolic)</td>
<td>Light brown</td>
<td>Yellowish green</td>
<td>Yellow</td>
</tr>
<tr>
<td>4</td>
<td>Powder + 1N HCl</td>
<td>Brown</td>
<td>Light green</td>
<td>Light brown</td>
</tr>
<tr>
<td>5</td>
<td>Powder + 1:1 H₂SO₄</td>
<td>Brown</td>
<td>Greenish yellow</td>
<td>Light brown</td>
</tr>
<tr>
<td>6</td>
<td>Powder + 1:1 HNO₃</td>
<td>Reddish brown</td>
<td>Light green</td>
<td>Dark brown</td>
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Table. 6 Physico-chemical characters of *Flacourtia indica*

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>1</td>
<td>Total ash</td>
<td>5.36</td>
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<tr>
<td>2</td>
<td>Acid insoluble ash</td>
<td>15.44</td>
</tr>
<tr>
<td>3</td>
<td>Water soluble ash</td>
<td>15.32</td>
</tr>
<tr>
<td>4</td>
<td>Extractive values</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Petroleum ether (40°-60° C)</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>b) Benzene</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>c) Chloroform</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>d) Ethanol</td>
<td>4.20</td>
</tr>
<tr>
<td></td>
<td>e) Water</td>
<td>15.54</td>
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</tbody>
</table>

Table. 7 Physico-chemical characters of *Flueggea leucopyrous*

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total ash</td>
<td>5.71</td>
</tr>
<tr>
<td>2</td>
<td>Acid insoluble ash</td>
<td>25.53</td>
</tr>
<tr>
<td>3</td>
<td>Water soluble ash</td>
<td>18.65</td>
</tr>
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<td>4</td>
<td>Extractive values</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Petroleum ether (40°-60° C)</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>b) Benzene</td>
<td>1.24</td>
</tr>
<tr>
<td></td>
<td>c) Chloroform</td>
<td>2.16</td>
</tr>
<tr>
<td></td>
<td>d) Ethanol</td>
<td>5.84</td>
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<tr>
<td></td>
<td>e) Water</td>
<td>10.20</td>
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Table 8: Physico-chemical characters of *Ventilago maderaspatana*

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Total ash</td>
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</tr>
<tr>
<td>2</td>
<td>Acid insoluble ash</td>
<td>5.12</td>
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<td>3</td>
<td>Water soluble ash</td>
<td>23.31</td>
</tr>
<tr>
<td>4</td>
<td>Extractive values</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Petroleum ether (40°-60°C)</td>
<td>1.68</td>
</tr>
<tr>
<td></td>
<td>b) Benzene</td>
<td>2.40</td>
</tr>
<tr>
<td></td>
<td>c) Chloroform</td>
<td>2.81</td>
</tr>
<tr>
<td></td>
<td>d) ethanol</td>
<td>12.34</td>
</tr>
<tr>
<td></td>
<td>e) Water</td>
<td>14.42</td>
</tr>
</tbody>
</table>

Table 9: Physico-chemical characters of *Stephania wightii*

<table>
<thead>
<tr>
<th>S.No</th>
<th>Particulars</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total ash</td>
<td>8.94</td>
</tr>
<tr>
<td>2</td>
<td>Acid insoluble ash</td>
<td>2.56</td>
</tr>
<tr>
<td>3</td>
<td>Water soluble ash</td>
<td>45.562</td>
</tr>
<tr>
<td>4</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>a) Petroleum ether (40°-60°C)</td>
<td>3.08</td>
</tr>
<tr>
<td></td>
<td>b) Benzene</td>
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<tr>
<td></td>
<td>c) Chloroform</td>
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</tr>
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<td></td>
<td>d) ethanol</td>
<td>9.80</td>
</tr>
<tr>
<td></td>
<td>e) Water</td>
<td>31.00</td>
</tr>
</tbody>
</table>
References


augmented oxidative stress in experimental type 2 diabetes, *Food and Chemical Toxicology*, 47(10), 2679–2685.


Chapter – II

Phytochemistry