CHAPTER 1

INTRODUCTION

1.1 Taxonomy

1.1.1 General introduction

Biological diversity is the manifestation of life on earth in multitudes of forms evolved over time and space at various levels like ecosystems, species and the genes. There are approximately 300,000 flowering plants inhabiting on earth. The systematic science endeavours to order this rich diversity by identifying and arranging them in to classification. Biodiversity is not distributed evenly, with a number of regions or ‘hotspots’ being extremely species-rich. There have been 34 hotspots identified, containing 44% of all plant species worldwide, and covering 1.4% of the Earth’s land surface. Some hotspots are richer than others and these tend to also be the most depleted habitats. Although 38% of the hotspots are protected by parks and reserves, there is still an urgent need of stronger safeguards to ensure their protection (Given, 1994; Maxted et al., 1997a & 2005; Myers et al., 2000; Schemske et al., 1994). As evolution and speciation are subjected to continued variation, frequent review of the natural wealth is inevitable to update their taxonomy. The over exploitation of natural resources by man, resulted in an irreparable loss of considerable biodiversity even before it was fully known (Mohanan & Daniel, 2005). Only 1.5 million of the estimated 30 million species are known to man and of which about 25 % are at the risk of extinction within the next two or three decades (Dutta, 2000).

1.1.2 Plant diversity in India & Kerala

India stands one of the 17 mega diversity countries of the World (Conservation International online) and has 3 out of 34 world hotspots, i.e. Indo-Burma, the Eastern Himalayas and the Western Ghats (Conservation International online). The flora of Western Ghats is estimated to be about 4,000 species (Nayar, 1996). It is estimated that the flora of Western Ghats forms about 25 % of the flora of India with a relatively high percentage of endemism. Out of the 4000 species, 1500 are endemic. The endemic species
in the flora of a geographical region reveal the biogeography of the area, centre of speciation and adaptive evolution (Nayar, 1996 & 1997). The degree of endemism increases with the increase in size of a homogenous biogeographical area having the same floristic history and ecological condition. In the Western Ghats, Southern part is the richest in terms of floristic diversity and endemism. Among the 4,000 species found in the Western Ghats, 3900 occur in the region which is spread over in three states viz. Tamil Nadu, Kerala and Karnataka, occupying an area of 12,000 km². About 95 percentage of species of the Western Ghats are reported to occur in Kerala (Nayar, 1996). The varied topographic features and climatic regions prevailing in the state, make Kerala become a land suited for diverse vegetation. The state harbours 4694 species in 1418 genera under188 families(s.l). Of these, 4078 are indigenous, 199 are exotic naturalized and 417 are cultivated/ planted. Of the 4078 indigenous species, 1568 are endemic to India and of these, 865 are endemic to Western Ghats. Of the 865 Western Ghats endemics, 237 species are endemic to Kerala. This includes two monotypic genera, Silentvalleya and Haplothismia. About 5% of the flora come under one or other IUCN red list category. Kerala constitutes only 1.18% of the geographical area of India but it accommodates 27.57% of the flowering plants occurring in the country(Nayar et al, 2008). The species richness and diversity are attributed to the topographic and climatic conditions prevailing in the state. Taxonomic studies play a very important role in the conservation of biodiversity. This also helps to use natural resources in an exact sustainable manner and pass the knowledge to the next generation.

### 1.1.3 Order Ranales

Order Ranales of Bentham and Hooker belongs to the Series Thalamiflorae of the Subclass Polypetalae of Dicotyledons. This is a primitive order and comprises primitive families like Ranunculaceae, Dilleniaceae, Magnoliaceae, Annonaceae, Menispermaceae, Berberidaceae, Nymphaeaceae, Cabombaceae and Nelumbonaceae and Calycanthaceae. It is characterized by (1) numerous floral parts, especially stamens and carpels, (2) floral parts arranged in spiral, cyclic or hemicyclic manner, (3) flowers hypogynous. The order is significant in terms of biodiversity and phylogenetic characters. This order shares some primitive characters with fossil plants (eg. strobilus of Bennettitalean gymnosperms-Magnoliaceae and the reproductive structures of Mesozoic cycads-Ranunculaceae). Several members of Ranales are pollinated by beetles (Cantherophilous).
1.1.3.1 Systematic position and affinities

Bentham and Hooker (1862-63) included eight families in this order and regarded it as the most primitive order of the dicotyledons. Arber and Parkin (1907), Bessey (1915), Hutchinson (1959, 1969), Takhtajan (1980) and Cronquist (1988) also considered Ranales (Magnoliiales) as the primitive order. Engler and Prantl (1897-1915) sub-divided this order into 4 sub-orders and placed 20 families except Dilleniaceae (which was kept in the order Parietales) under the order and kept in the middle of the Dicotyledons by considering they are advanced. According to Bessey, Ranales are the most primitive flowering plants which gave rise to three separate phyla of flowering plants. One of these give rise to Monocotyledons the other two give rise to dicotyledons.

Because of the similarity in the general structure of the reproductive structures in Mesozoic cycads and members of Ranunculaceae, the later is regarded as a primitive family of angiosperms. It has affinity and relationship with Berberidales, Magnoliaceae and Alismaceae, Hydrocharitaceae of monocotyledons. Magnoliaceae is considered by many taxonomists as the primitive most angiosperm family because its flowers are compared to the strobilus of Bennettitales of Gymnosperms. Hallier (1905) compared the elongated floral axis bearing numerous spirally disposed carpels with sporophyll bearing axis of the Bennettitales. Arber and Parkin (1907) and Lotsy also support the primitive nature of the family. Hutchinson (1959, 1969) considered the Magnoliaceae as the primitive most angiosperm family. Takhtajan (1980) and Cronquist (1981) also considered the Magnoliaceae as primitive family in Angiosperms. Engler (1897-1915) considered the Magnoliaceae as a little advanced and kept in the middle of the dicotyledons. Schisandraceae related to Magnoliaceae. Annonaceae is considered to have been derived from Magnoliaceae. Myristicaceae and Annonaceae are closest because both of them have basic chromosome number (n=7), ruminate endosperm and open primary xylem. Bentham and Hooker divided the Nymphaeaceae in to three subfamilies viz., Cabomboideae, Nelumboideae and Nymphoideae. Bessey (1915) treated each as a distinct family and placed the Cabombaceae and Nelumbonaceae in the Ranales and removed the Nymphaeaceae (sensu stricto) to the Rhoeales. Hutchinson (1959, 1969, 1973), accepted the Cabombaceae, but retained the other two subfamilies within his concept of Nymphaeaceae. Takhtajan (1980) recognized them as the independent families viz., Nymphaeaceae, Cabombaceae and Nelumbonaceae.
With much variation in the circumscription of this order it becomes difficult to
discuss its characters and relationships. For convenience the order is described in the
thesis as defined by Bentham and Hooker.

**1.1.3.2 Primitive characters of Ranales**

1. Predominantly arborescent habit (Trees and shrubs)
2. Simple, stipulate leaves
3. Absence of vessels (Magnoliaceae)
4. Solitary flowers
5. Spiral arrangement of the floral parts
6. Indefinite number of floral parts
7. Bisexual or hermaphrodite flowers
8. Actinomorphic flowers
9. Free floral parts, ie. Polysepalous, polypetalous, polyandrous and
   apocarpous condition
10. Undifferentiated calyx and corolla
11. No adnation or fusion of different parts of the flower
12. Elongated thalamus and hypogynous condition
13. Laminar stamens and connectives produced beyond anther lobes and are
   with four microsporangia
14. Insect pollination (Cantherophili)
15. Large endospermic seeds with a small and undifferentiated embryo
16. Large cone like fruits consisting of large and many seeded follicles
   developing from polycarpellary apocarpous gynoecium

**1.1.3.3 General Characters**

**Habit:** The plants shows variations in habit. Members of Magnoliaceae and majority of
Annonaceae and Dilleniacae are trees, Some members of Annonaceae are shrubs
(Desmos) or climbers(Uvaria, Artabotrys). Majority of the Ranunculaceae members are
herbs but some are climbers (Clematis). They may be terrestrial, amphibious(some
members of Ranunculaceae), or aquatic(Nymphaeaceae, Cabombaceae and
Nelumbonaceae).
Leaves: Alternate. Whorled in *Dillenia indica*, opposite in *Clematis* exstipulate in Annonaceae, stipulate in Magnoliaceae, Dilleniaceae, Berberidaceae and in *Thalictrum* of Ranunculaceae. In most of the plants leaves are simple but some plants have compound leaves (*Clematis*).

**Flowers and floral parts:** Flowers exhibit most of the primitive characters as explained above. But in Menispermaceae flowers are dioecious. Ovules are anatropous.

**Fruits:** The fruits are aggregate of achenes, berries or follicles

**Seeds:** Seeds are large and have abundant endosperm and a comparatively small embryo in some families (Magnoliaceae, Annonaceae). The testa in Magnolia has an outer fleshy layer (sarcostesta). In Annonaceae the endosperm is ruminate

**Pollination:** By means of insects (Beetles-cantherophilous)

1.1.3.4 Geographical distribution and present status

In the world the order Ranales is represented by approximately 5895 species in 307 genera. Ranunculaceae is represented by about 1800 species in 62 genera, mostly herbs, which are widely distributed in all temperate and subtropical regions. In the tropics they occur mostly in higher elevations. Ranunculus is the only genus in this family with a true sepals and petals. The Dilleniaceae are trees, shrubs or occasionally vines comprising 10 genera and 350 species. Distributed in the tropics, subtropics and entire Australia. Magnoliaceae comprises about 225 species in 7 genera. The family ranges across eastern north America, Mexico and Central America, the West Indies, tropical South America, tropical and temperate Asia from the Himalaya (Srilanka, Indochina, Malesia, China, New Guinea and Korea) to Japan. Asia is home to approximately two third of the species in Magnoliaceae. Shisandraceae is represented by 2 genera in 47 species. Found in tropical to temperate regions of East and Southeast Asia and the Caribbean. Annonaceae (custard apple family) comprises of trees, shrubs or rarely lianas. Consists of about 2400 species in more than 130 genera. It is the largest family in Ranales. The family is concentrated in the tropics with few species found in temperate region. About 500 species are neotropical, 450 are Afrotropical and the other species Indomalayan. Menispermaceae comprises 70 genera in 420 species. Most of them are climbers. Great majority of genera are tropical but with a few (notably *Menispermum* and *Cocculus*) reaching temperate climates in Eastern, North America and eastern Asia. Berberidaceae consists of 15 genera and 570 species of which majority are in Berberis (450). Nymphaeaceae live in fresh water areas with 8 genera and
70 species and is found in temperate and tropical climates around the world. *Nymphaea* alone contains 35 species across northern hemisphere. Cabombaceae (fan wort family) comprises 2 genera (*Brasenia* and *Cabomba*) and 6 species which are found in temperate to tropical fresh water areas and cosmopolitan except Europe. Nelumbonaceae (Lotus family) is the smallest family in the order with one genera (*Nelumbo*) and 2 species (*N. lutea* - American lotus, *N. nucifera* - sacred lotus), found in subtropical to tropical, Eastern USA to Colombia and warm Asia to Northeast Australia.

In India it comprises 377 species in 88 genera distributed in 10 families *viz.*, Ranunculaceae (91 species in 28 genera), Dilleniaceae (12 species in 3 genera), Magnoliaceae (24 species in 3 genera), Schizandraceae (2 genera 2 species), Annonaceae (120 species in 24 genera), Menispermaceae (43 species in 20 genera) Berberidaceae (68 species in 3 genera), Nymphaeaceae (7 species in 2 genera), Cabombaceae (9 species in 2 genera) and Nelumbonaceae (1 genus and 1 species).

In Kerala it comprises 101 species in 43 genera distributed in 10 families *viz.*, Ranunculaceae (12 species in 5 genera), Dilleniaceae (7 species in 3 genera), Magnoliaceae (2 species in 1 genera), Schizandraceae (1 genus & 1 species), Annonaceae (52 species in 17 genera), Menispermaceae (18 species in 11 genera) Berberidaceae (2 species in 2 genera), Nymphaeaceae (4 species in 1 genus), Cabombaceae (2 species in 1 genus) and Nelumbonaceae (1 genus and 1 species).

### 1.1.3.5 Economic Importance

Some members of Ranales are economically very important. Species of *Ranunculus* are ornamental and *Naravelia* is medicinal. Species of *Dillenia* except *D. indica*, *Michelia champaka*, *Artabotrys*, *Cananga odorata*, *Polyalthia longifolia*, *Nymphaea* and *Nelumbium* are ornamental. *Dillenia pentagyna* is timber yielding. Species of *Annona* except *A. glabra* are cultivated for its edible fruits. They are medicinal also. Many species of Menispermaceae (eg. *Cyclea*, *Tinospora*, *Coscinium* etc) are medicinal.

### 1.2 Ethnobotany

Plants are fundamental to almost all life on earth, providing protection and sustenance for organisms ranging from bacteria to large mammals. The familiarity with plant species producing medicine, essential oil and insecticides dates back to the beginning of civilization. The tribal people and ethnic races throughout the world have developed
their own cultures, customs, cults, religious rites, taboos, totems, legends and myths, folk tales and songs, foods, medicinal practices, etc. Numerous wild and cultivated plants play a very important and vital role among their cultures and this inter-relationships has evolved over generations of experience and practices. Traditional societies throughout the world possess a wealth of such knowledge which they have accumulated during prolonged interaction with the natural world, and which remains fundamental to their physical, spiritual and social well-being.

The term ‘Ethnobotany’ was first used in 1895 by Harshberger. Since its conception ‘Ethnobotany’ has proved a rather difficult term to define. Harshberger himself, regarded it as simply the use of plants by aboriginal peoples, yet during the century which has intervened, considerable attention has focused not only on how plants are used, but also on how they are perceived and managed, and the reciprocal relationship between human societies and the plants on which they depend. Today, Ethnobotany deals with the direct relationship of plants with man and includes studies such as food, fibre, dyes, tannins, medicinal and harmful plants, taboos and magico-religious believes about plants (Jain, 1987). Ethnobotanical studies assume great importance in enhancing our knowledge about the plants grown and used by native / tribal communities, the rich diversity assembled by them for their sustenance and different means adopted by them for its conservation / preservation (Arora, 1997).

Traditional knowledge survives usually among the indigenous and local communities. They are not confined to rural or remote areas, many highly educated families living in urban areas and even in foreign lands continue to follow many tradition. (Jain, 2004). The information about medicinal plants is also belongs to village physicians, chieftains of different communities and other members of the family. Traditional healers include both tribals and non-tribals of different communities. A number of different believes are prevalent among villagers. But they rarely hold any common notion about any particular diseases. Some of the therapeutic herbal recipes and curing techniques might have been borrowed from the neighbouring cultures (Nisha & Sivadasan, 2007). Another important source of ethnobotanical information is ancient or unnoticed, published or unpublished literature. Vast heritage of Vedic literature can be used as a valuable ethnobotanical source (Jain, 1981)

Herbarium sheets and museum specimens and field notes are also proved to be a very good source of ethnobotanical data (Jain, 1981).
Since the early ethnobotanical studies in aboriginal plant use, the scope of the subject has expanded enormously, encompassing the botanical aspects of a number of ethno scientific fields including ethnomedicine, ethnotaxonomy, ethnoecology, traditional agriculture, cognitive ethnobotany, material culture, traditional phytochemistry, ethnopharmacology, palaeo ethnobotany, etc. Several crop plants have originated and diversified in the agro-ecological regions where native communities have their abode. Tribal communities in many regions still practice gathering of wild useful plants to supplement their needs. So ethnobotany has its role in the conservation and use of plant genetic resources (Arora, 1997). Continuous use of isolated active ingredients of herbs in pure form and formulated synthetic compounds are often associated with harmful side effects. The WHO (World Health Organization) has recognized the role of traditional systems of medicine and considers them a part of strategy to provide healthcare to the society (Lalramnhginglova, 1999).

There is a steady decline in human expertise capable of recognizing various medicinal plants. Much of the wealth of knowledge is totally becoming lost as traditional culture gradually disappears (Hamilton, 1995). Thus there is now an urgency for ethnobotanical research amongst aboriginal peoples (Maheswari, 1983). According to Rao (1996) there is an urgent need to inventorise and record all ethnobiological information among the diverse ethnic communities before the traditional cultures are completely lost. Many of these traditional knowledge are often kept as guarded secret passed on from father to son. “It is to discover these hidden and secret uses of the flora of our land, that Ethnobotany has become an important part our investigation” (Janaki Ammal, 1978).

1.3 Objectives of the study

Since Kerala is a treasure house of ethnic communities, some ethnobotanical surveys were conducted in this region. But all these studies were conducted on district wise or community wise. Ethnobotanical studies in a classification line is very rare. The main objective of this work is to present a holistic systematic and ethnobotanic treatment of the order Ranales in Kerala state. Village chieftains and traditional healing practitioners are using local names to identify the plant and it varies from village to village. So the role of a taxonomist or botanist is very essential to document ethnobotanical data in a scientific form. A taxonomical approach to ethnobotany could bring all the scattered information from regional floras, herbarium, journals and traditional healing practitioners under a
single head. This will help to prepare an ethnotaxonomical flora. This will help scientists, academicians and others to study more about this order. This is also expected to highlight the conservation value and the status of the members of Ranales in the state and their utilization for the economic development of the region and its people