Chapter 1

Introduction
1. INTRODUCTION

General Introduction

The merit of plants in medicine, agriculture and economic development is clearly aware to human population since many decades. Hence, Phytomedicines are powerful drugs to cure many diseases with less or no side effects, available at low cost and thus the comprehensive importance of medicinal plants is increasing day by day (Yadav and Munin, 2011).

Herbal medicines perform a crucial responsibility in highly developed conventional therapeutic systems such as long established Chinese traditional medicine and Indian Ayurvedic system of medicine. They have been considered as hub in remedial ritual of Romans and Greece people, these customs further surfaced as present-day biomedicines. (Griggs, 1997; Wohlmuth, 2008).

Plants have been of immense magnitude owing to their nutritive assessment and as a basic component of medications. A striking number of herbal commodities and prevailing drugs have been segregated from plants. Copious classes of edible wild plants are exploited as resources of food and consequently afford an acceptable amount of nutrition to the population (Borkataky et al., 2013).

The self availing of medicinal plants for alleviating illness in animal population is most primitive than the human species. Wide spread annotation in utilization and prospectivity of medicinal plants contribute radically in revealing of their therapeutic properties, therefore, they are frequently recommended, even if their chemical components are not known and always from tip to toe. Studying medicinal plants will help to understand plant toxicity and to protect human and animals from natural poisons. More than 500 plant species were used by Hippocrates (468-377 BC)
for therapeutic use, De Materia Medica an important manual of medicinal plants was written by Dioscorides, a Roman surgeon (Wohlmuth, 2008).

Based on the conventional exploitation of herbal medicine as powders, liquids or combination, it has been the fundamental remedy for a variety of disorders in India since primeval times. At present thirty to forty percent of traditional medicines are employed in the therapeutic and restorative ability of different herbal supplements, botanicals, neutraceuticals and drugs which are isolated from plants (Borkataky et al., 2013).

According to World Health Organization, the traditional medicine is – “The sum total of the information, skills and practices based on the speculations, faiths and experience native to different cultures, whether it interpretable or not, but used in the maintenance of health and also in the prevention, diagnosis, betterment or curing of physical and psychological disorders” (WHO, 2000).

Ethnobotany and ethno pharmacology are the integral part of traditional system. The word ethnobotany is not widely accepted definition. But in general it is defined by Harshberger (1896) as “The use of plants by aboriginal peoples”. After that ethno botany has been redefined and reinterpreted by many researchers. Several ethno botanists are of keen interest about history of ethno botany as the ancient ethno botany which has thrown light on the plants of economic importance, while modern ethno botany focus on broader scope including traditional agro knowledge and managing vegetation traditionally (Wohlmuth, 2008).

Ethno pharmacology is a multidisciplinary field attributed to the study of pharmacologically active compounds which are traditionally used by mankind. The word ethno pharmacology was coined by Henry in 1967; He used the term in fully understanding psychoactive agents.
Improvement and bulk manufacturing of chemically produced drugs have transformed health care system across the world. On the other hand large number of population in developing nations relay on conventional specialists and herbal medicines (Galor and Benzie, 2011).

Till today 70% of Indians and 90% of Africans meet their health care needs through traditional medicine. In China it accounts around 40% of total health care addressed and more than 90% of general hospitals have many divisions of traditional medicine. It is noticed that, the use of traditional medicine is not only restricted to developing nations, but also extended significantly to industrialized countries with increasing the use of ethnobotanicals. General survey of United States in 2007 indicated that there are about 38% of adults and 12% of children and was treated with conventional medicines (Galor and Benzie, 2011).

**Phytotherapy**

The term phytotherapy denotes the use of plant origin complex chemicals and therapeutic agents, especially in developed countries. The practice of phytotherapy is based on the history of traditional use, but it differs from conventional herbal medicine available in native by employing extraction and manufacturing techniques. Therefore, the herbal medicines prepared by plants are available in many industrialized countries at affordable prices.

Ethno pharmacology has entailed the knowledge of traditional medicine which enables to understand the mechanism of action, method of preparation and method of usage with precautionary measures to get striking effect.

It is hard to understand the pharmacology of traditional herbal medicine and modern phytomedicine due to their complex nature of chemical composition. Pharmacological investigations of plant extracts mainly concentrate on bioactive
principles which have intense biological activity. The pharmacokinetic/ the pharmacodynamic properties of the bioactive compounds reveal that the complex of compounds present in the plant extracts could synergetically play a significant role.

Phytochemistry is the study of chemical components present in plants, and the method of describing the isolation, purification and elucidation of the structure of large number of phyto constituents found in plants and the study of physiological processes of plants in relationship to the products of plant metabolism (Alfred, 1937).

The study of interaction of drugs with living organisms is called pharmacology. Which also includes history, source, physicochemical properties, dosage forms, methods of administration, absorption, distribution, mechanism of action, biotransformation, excretion, clinical uses and adverse effects of drugs (Teferra, 2004).

Medicinal Plants

‘The term ‘medicinal’ as applied to a plant indicates that it contains a substance or substances which modulate beneficially the physiology of sick mammals, and that it has been used by man for that purpose’ (Anna, 1993).

Medicinal Plants are- “All higher plants that have been alleged to have medicinal properties, i.e., effects relate to health, or which have been proven to be useful as drugs by western standards, or which contain constituents that are used as drugs”
Characteristic features of medicinal plants

- **Synergic medicine**- The ingredients of plants all interact simultaneously, so their uses can complement or damage others or neutralize their possible negative effects.

- **Support of official medicine**- In the treatment of complex cases like cancer diseases the components of the plants proved to be very effective.

- **Preventive medicine**- It has been proven that the component of the plants also characterized by their ability to prevent the appearance of some diseases. This will help to reduce the use of the chemical remedies which will be used when the disease is already present i.e., reduce the side effect of synthetic treatment (Bassam, 2012).

**Scenario of medicinal plants in India**

India is known as the Botanical Garden of the globe and emporium of medicinal plants owing to her wealth of phytomedicines. India’s great topographic and climatic diversity has a very rich and diverse plants and animals. The significant and most primitive and important documents which on herbal medicine skills was found to be exist since 1500 BC Rig Veda. Indian herbalists like Maharshi Charaka and Sushruta were investigated on various herbal plant parts for the treatment of various disorders of human body (Sinhababu and Banarjee 2013).

Exploitation of medicinal plants by ethnics for their use in India is being practised over a millennium. Maximum use of Indian plants as drug is drawing attention of world since several years. Ancient Indian universities such as Takshashila (700 BC) and Nalanda (500 BC) were the educational places to visit by people of China, Cambodia, Indonesia and Bagdad to learn health sciences of India. The smoke of Datura plant is used for treating asthma, anux vomica for paralysis and indigestion as stated by Dioscorides. It is noticed that the Indian people have an immense interest
for medicinal plants and their use for the treatment of health related diseases from simplest flu to memory enhancement and dealing of poisonous snake bites to a healing for muscular dystrophy and to increase of immune power of the body.

In recent years ethnicity has become an important knowledge for western health practitioners, but few of them have the opinion that only modern system of medicine is effective and unique. In most of the cases it will reach to a limited number of people, and approximately more than 70% people of the world are out of reach from this conventional medicine treatment. Affordability of allopathic medicine by poor people is difficult because of high cost and far too capital intensive for a developing nation like India, This may be the reason for over seven million people of India who receive treatment from local practitioners on the basis of Ayurveda, Siddha and Unani medicine.

Looking into the poverty and affordability of medicine by the people Our first Prime Minister Mr. Jawaharlal Nehru and former Prime minister Mrs. Indira Ghandi have encouraged the amalgamation of the finest of home-grown medicine with advanced medicine by establishing the Central Council of Indian medicine, a government statutory organization (MelBorins, 1987).

Medicinal plants, as a group, comprise approximately 8000 species and account for about 50% of all the higher flowering plant species in India. A large number of the country’s rural population depend on medicinal plants for treating various ailments. More than 1.5 million practitioners of the Indian Systems of Medicine and Homeopathy (ISM & H) use medicinal plants for preventive, curative and promotive applications (Govt of India Planning Commission, 2000).

There are around 7850 registered ISM pharmacies and 851 of homoeopathy as well as a number of unlicensed small-scale health care divisions are existing in India.
The agricultural-biodiversity of India is distributed in 8 very diverse phyto
geographical and 15 agro ecological regions. The range of distribution of these plants
varies from the wet evergreen forests in the Western Ghats to the Alpine scrubs of the
Himalayas; from the arid deserts of Rajasthan to the mangroves along the east coast;
from the vast deciduous forests of the Deccan to the Shoals of the high ranges; from
the swamps of the Ganges to the moss laden tree trunks of the Silent Valley. The
aboriginal or indigenous diversity of plant species of medicinal and aromatic
importance in the territory is irreplaceable. (Satyabrata, 2004)

Out of 12 mega biodiversity centres in the world, India is one to its kind.
India’s biodiversity is beyond compare because of existence of 16 different agro-
climatic zones, 10 vegetative zones and 15 biotic provinces. The country has 45,000
plant species, 15,000–18,000 flowering plants, 23,000 fungi, 2500 algae, 1600
lichens, 1800 bryophytes and 30 million micro-organisms. Large variety of flora and
fauna bearing medicinal properties are present across ocean line attributing to its 3/4
of its land exclusive economic zone. Among 1500 plants with medicinal uses are
stated in ancient manuscripts, only about 800 plants have been used in conventional
remedy (Kamboj, 2000).

India’s Herbal Business in Global Market

The use of herbal drugs is on the stream and the market is rising gradually
every year. The export of medicinal plants and herbs from India has been moderately
high in the last few years. India stands at second place in the global market for the
production of 1,25,000 tonnes of castor seeds per annum. Recently India exported
some pharmaceuticals such asisobgol, opium alkaloids, senna derivatives, vinca
extract, cinchona alkaloids, ipecac root alkaloids, solasodine, Diosgenine, Menthol,
gudmar herb, mehdi leaves, papian, rauwolfia guar gum, Jasmine oil, agar wood oil, sandal wood oil, etc.

In India the market of herbal medicines is contradict to, classical formulations and home remedies of traditional systems of medicine and it is estimated about around $ 1 billion, where as the export of herbal crude extract is about $ 80 million. Herbal medicinal industries turnover is around Rs. 2,300 crore per annum where as the pharma business turnover is Rs. 14,500 crores. It remarkably indicates the growth rate of 15 percent.

List of herbal formulation manufacturing companies in India

- Acis Laboratories, Kanpur
- Allen Laboratories, Kolkatta
- ALRASIN Marketing, Mumbai
- Amil Pharmaceutical, New Delhi
- Ansar Drug Laboratories, Surat
- Baidyanath Ayurveda Bhavan, Jhansi
- Bharti Rasanagar, Kolkatta
- Charak Pharmaceuticals, Bombay
- Dabur India Ltd., Ghaziabad
- Dattatraya Krishan Sandu Bros., Mumbai
- Hamdard (Wakf) Laboratories, Delhi
- Herbals Pvt. Ltd., Patna
- Herbo-med (P) Ltd., Kolkatta
- Indian Herb & Research Supply co., Shharanpur
- J & J Dechane Laboratories pvt. Ltd., Hyderabad
- Kruzer Herbals, New Delhi
Madona Pharmaceutical Research Pvt. Ltd., Kolkatta
Shilpachem, Indore
The Himalaya Drug Co., Bangalore
Zandu Pharmaceutical Works Ltd., Bombay

(Himalaya, Zandu, Dabur, Hamdard, Maharishi, are the traditional pharma companies, and Ranbaxy, Lupin, Allembic, Himalya and Reliance are the modern sectors involved in studying their herbal products by employing HPLC and TLC techniques.

Around 7000 micro industries are manufacturing traditional medicine either by standardization or without standardization. Despite the use of pharma companies standardized herbal formulations by active compounds, they did not confirm the bioactivity of drugs through experimental tests in animal models (Kamboj, 2000).

India plays a significant role in supplying of herbal products to meet out the domestic needs and also has great advantage of export quality. India attracts global herbal market by manufacturing at international quality:

• Proper botanical identification of all medicinal plants in Indian System of Medicine.
• Processing of medicinal plants in a scientific, economic and safe way by using similar used for modern drugs.
• Isolation and chemical characterization of active principles including inorganic compounds.
• Pharmacological and clinical research to ensure their potentiality and safety.
• Standardization to establish homogeneity.
• Documentation of scientific research. (Alok, 2008).
Phytochemical and Pharmacological Profiling of Ficus glomerata Roxb

Phytocompounds

The indolence of plants in different and altering physical atmosphere, in conjunction with the chances of damage by animals and pathogens, are imposed plants to the production of number of chemical mechanisms for defence and offence. Phytochemists have given more attention towards the study of specific biological role of secondary metabolites, which are commonly considered as waste products in plants.

Primary metabolites such as carbohydrates, proteins, fats and oils are used as source of food by all herbivorous animals including man. Non-nutrient chemical compounds of plant or bioactive components are often referred to as phytochemicals (phyto- from Greek; phyto meaning ‘plant’) and which are responsible for protecting the plant against microbial infections or infestations by pests. Though the nutrients elicit pharmacological or toxicological effects when taken at high concentrations (e.g. vitamins and minerals), they are not considered as bioactive compounds.

The classic bioactive compounds in plants are synthesized as secondary metabolic products. Hence, a bioactive compound in plants can be defined as: secondary plant metabolites eliciting pharmacological or toxicological effects in man and animals.

These compounds generally exhibit curious, unmatchable and play a particular active physiological functions, accountable for their medicinal and pharmacological actions. Such naturally occurring compounds having medicinal values are used to help the needs of mankind (Moronkola, 2012; Askel, 2010; Siti, 2013).

Study of secondary plant metabolites are useful to conserve their bioactivities and their standardization as well; when compared with the crude herbal methods that
are difficult to standardize. Phytochemicals are in complex nature and they are present in very small quantity in grams or mg or μg/Kg of plant material.

Phytochemicals do not provide energy to the plant but they are utilized for therapeutic purpose for repairing and defence. Higher plants contribute to meet out around 25% of prescribed drugs. Out of 2,50,000 higher medicinal plants half of which are distributed in tropical forests; of these plants 60% are shown to have biological active components and their biological functions are proven, only 15% of them are reported for isolation of phyto-compounds (Dorcas, 2012).

**Importance of phytochemicals**

More or less 65% of the world’s population have imbibed the merit of plants as a methodology of medicinal representative in their basic health care. Which include phyto-drugs and medications as per the guidelines of World Health Organization, now a day’s developing nations are moving towards the application of plant based ancient medicinal system. Drugs which are prescribed today contain basically plant sources. This observation indicates that the plant-based molecules comprise an important portion of natural product which is plant origin biopharmaceuticals. Secondary metabolites are classified into many families. Out of these families, nitrogen-containing alkaloids have been part of the largest number of drugs, they are most effective from anticholinergics (atropine) to analgesics (opium alkaloids) and from antiparasitics (quinine) to anticholinesterases (galantamine) to antineoplastics (vinblastine/vincristine), terpenoids (including steroids). These above said drugs have contributed equally to the health care of mankind which include from Na+/K+ pump-inhibiting cardiac glycosides from Digitalis spp., to antineoplastic paclitaxel , antimalarial artemisinin, anti-inflammatory triptolide. (Manaskumar et al., 2012).
Application of scientific methods for screening of plant extracts or plant derived substances even now stays an attention grabbing approach to search for new lead compounds in many plant species. Medicinal plants symbolizes a rich source of health promoting agents. Different countries are utilizing plants as source of potential and powerful medicines. Deciphering the valuable properties of the plant derived chemical compounds is advantageous not only for unearthing of healthcare products, but also in discovering new sources of commercially important materials like alkaloids, tannins, oils, gums etc., (Kumaraswamy et al., 2012).

**Synthesis of metabolites and their function in plants**

Primary metabolites such as carbohydrates, amino acids, proteins and lipids are synthesized in plants via regular biosynthetic and metabolic routes are essential for routine growth and development of plants; apart from this they also produce secondary metabolites. These secondary metabolites are synthesized by plants through different pathways which are not similar to regular biosynthetic pathways. Hence, secondary metabolites are considered as products of biochemical “side tracks” in the plant cells as they are not necessary for normal functioning of the plant. Secondary metabolites act as defensive agents includes major classes such as Flavonoids, Terpenoids and Alkaloids.

The flavonoids are water soluble polyphenolic molecules containing 15 carbon atoms; belong to the polyphenol family (Kirankumar and Londonkar, 2014). Flavonoids can defend against free radicals produced during photosynthesis. Terpenoids which are also called as resins of pine tree contain resinic acid and some carbohydrates (Breitmaier, 2006). These compounds are more fascinating towards pollinators or seed dispersers, or inhibit competing plants. Alkaloids are basic (alkali-like), nitrogen-containing organic constituents found in some plants. They are usually
resistant to herbivore animals or insect attacks (phytoalexins) on plants. They also work as signalling molecules or may exert some other roles in different plants. Most of the common food and feed plants are able to synthesize such compounds.

Though, the common poisonous or medicinal plants have higher concentrations of potent bioactive compounds than the food and fodder plants. Phylogenetic study of secondary metabolites reveals that they are synthesized randomly and they are possess specific function. However, all of these metabolites are known to have credible functions in plants (Askel, 2010).

**Need of alarm to the scientific community**

The role of plants in treating diseases or to prevent illness by the plant based herbal formulations and even manufacturing of modern drugs is well established. The search of herbal drugs and preparation of their formulations was based on the long, risky and self experimental trials of the human population. Establishment of critical evidence of medicine for exactly does what it is claimed to do and also identification of bioactive compound in plants by chemical analysis are the two factors are twined together (Swati et al., 2012).

The evolution of resistant genes to the antibiotics, synthetic compounds and microbial sources, is drawing attention on health care research to shift towards the medicinal plants. Chemo preventive and chemotherapeutic capability of plant based compounds are created a great interest in the fields of ethno botany and complementary medicine to search for reliable bioactive compounds (Kalaivini, 2013).

Public health and basic health care system have become main issue in most of the developing countries, which is badly lagging at the basic level, both in the fast developing cities and in the rural areas. As per the studies of World Health
Organization more than 50% of the world’s population lacks access to adequate health care services. The reason behind this is poor financial condition of the people to afford the therapeutic medicine which prevent often health care services (Kumbhare et al., 2012).

Even the WHO acknowledges the importance of traditional medicine which plays a significant role in providing health services to largest section of community including rural areas. Large amount of fund for extensive research work and time are required to expand better medical facilities to all sectors of the people particularly to those of economically weaker residents of the rural area.

Sufficient and better health care facility can be provided at low cost if the availability and accessibility of medicinal herbs and other traditional medicines are in plenty at local area. Considering the above observations the world health organisation is supporting and promoting the local public bodies to strengthen the extensive research, training facility and documentation of traditional knowledge on medicinal plants (MelBorins, 1987).

Therefore, systematic strategies are essential to overcome the problems related to traditional medicine. Medicinal plants provide alternative solutions with remarkable prospects. By providing access and inexpensive to populace of the society; they also serve as the sources for income generation, creating jobs and foreign exchange for developing countries (Kumbhare, 2012). Greater interest has been created in many countries for the exploitation of medicinal plants which contribute to cure the major diseases and also supply raw materials to the cosmetic, neutraceuticals and beverage industries.
Maximum number of medicinal plants should be scrutinized to appraise their properties, isolate the bioactive, lead compounds for therapeutic uses and to test their efficacy and toxicity (Kalaivani, 2013).

**Plants of Moraceae family**

Family moraceae includes trees, shrubs, and herbs. They grow as epiphytic or hemiepiphytic and they may be dioecious or monoecious. Latex produced through lactiferous system is accumulated in leaves and bark. Moraceae is often called as mulberry family, which are closely related to the Ulmaceae and Urticaceae family plants. Mulberry family is divided into 5 classes as per new system of classification which are Artocarpeae, Castilleae, Dorstenieae, Ficaceae and Moraceae.

General habitat of Moraceae family, the plants are distributed in tropical area. It includes 53 genera and 1400 species of plants. Ficus and Artocarpus are the most common plants of this family. Majority plants of Moraceae family are almost consists of wild trees and bears thorn.

Trees, herbs, shrubs and woody climber plants can be seen in Moraceae family. Plants may be either terrestrial or hemiepiphytic, flowering conditions is dioecious or monoecious. Arrangements of leaves are alternate. Both leaves and Barks usually secrets white milky latex. Due to shortening of stem some species in Moraceae family have rosulate leaves. The common types of fruit found in Moraceae are stone fruits. These kinds of fruits are woody in nature and are surrounded by sticky outer surface.

**Genus: Ficus**

Plants of genus Ficus usually grow in subtropical and tropical forests. This genus includes 800 different species and 2000 varieties of plants. The fig genus is
called Ficus. The figs differ very much in their sizes; and some are very small (Salem et al., 2013).

Fig trees produce three different kinds of flowers: which are male flower, female flower and gall flower. Male flower has stamens and female flower has ovary which is capable to produce little fruit having single seed. The third type of flower i.e gall flower is alike female flower but it is incapable to produce a seed. *Ficus benjamina* tree bear all three types of flowers in same plant.

All parts of Ficus plant have their own therapeutic applications. Plants of different species of Ficus share common characters in their physical features and chemical compounds.

**Ficus glomerata Roxb**

**Botanical description**

*Ficus glomerata* Roxb or *Ficus racemosa* Linn belongs to the family of Moraceae; distributed throughout the greater part of India, found in shady, moist localities also cultivated in villages for its fruit. It is an evergreen medium to large sized in spreading, latex secreting deciduous trees bear no prominent arial roots. The leaves are dark in colour measuring about 7.5 -10cm long and elliptic in shape. The fruits are 2-5cm in size and they are pear shaped found in large clusters emerging from main branch with a stalk. All parts of the plants are medicinally important and therefore they are used as fodder, food and ceremonial purposes. (Arunachalam, 2010; Anita rani, 2011).

**Botanical Classification**

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### Phytochemical and Pharmacological Profiling of Ficus glomerata Roxb

<table>
<thead>
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<tr>
<td>Synonym</td>
<td>F. racemosa linn.</td>
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**Synonyms**

- **Sanskrit**: Sadiphala
- **English**: Cluster fig
- **Hindi**: Gulara, Gular
- **Kannada**: Atti hanninamara, Attigida
- **Marathi**: Umber
- **Tamil**: Atti
- **Telugu**: Atti, Medi

**Traditional uses**

The *Ficus glomerata* has many synonymous names like Udumbara, Yajnanga, Yajniya, Yajnayoga, Yajnasara, Gular, Cluster fig and Ficus racemosa in different languages of the country.

The Udumbara is considered as sacred tree to Dattaguru and Lord Buddha. It is one of the plant from a group, called Panchavalkala, meaning the thick bark skins of five milk secreting trees such as Udumbara, Vata, Asvattha, Parisa and Plaksa. Decoction of panchavalkala is used for treating internal bleeding. Charka has mentioned Udumbara for Muttra sangrahaniya as anti-diuretic herb. Sushruta has described the medicinal properties of the plant to astringent helps callus healing, eases Rakta pitta, burning sensation and obesity. The juice of fruit of this plant is used to elevate cough and dysentery (Choudhary and Sachin, 2012; Arunachalam, 2010).

**Implications of the Study**

The literature survey on the plant *Ficus glomerata* Roxb indicates that the plant is a rich source for medicinally important compounds and there is no much
scientific validation on this plant. Hence, it is aimed to study the phytochemical and pharmacological profiling of *Ficus glomerata* Roxb is under taken.

**Objectives of the study include**

- Collection, identification and processing of the plant material.
- Extraction of phyto constituents using different solvent systems.
- Preliminary phytochemical and pharmacognostic studies of plant extracts.
- Screening the antimicrobial potency of plant extracts against pathogenic microbes.
- Evaluating the free radical scavenging ability of methanol extract of fruits of *Ficus glomerata* Roxb under *in vitro* test systems.
- To check the therapeutic potentials of methanol extract of fruits of *Ficus glomerata* Roxb against carbon tetra chloride induced Hepato toxicity in animal models.
- To study the antimitotic activity of methanol extract of fruits of *Ficus glomerata* Roxb in onion root tips.
- To check the clot lysis activity of methanol extract of fruits of *Ficus glomerata* Roxb.
- Isolation, Purification and Characterization of flavonoid from methanol extract of the plant.
- *In vitro and in vivo* study of anticancer activity of isolated flavonoid against prostate cancer.