Chapter 1. General Introduction

About this Chapter

This chapter gives a general introduction on the etiology of medicinal plants, its gradual evolution in relation with human life, its significance and present status on an Indian perspective, scientific explanations for medicinal properties of plants, relevance of antimicrobial studies and the aims and work plan of the present study.
Chapter 1

General Introduction

Fabulous developments of medicine as a leading branch of science have made a
significant role in the survival and well-being of man. The uses of medicine, sometimes,
have started with the first man and have developed through centuries as civilization
advanced. Primitive man used plants primarily for the appease of his hunger.
Occasionally through several experiences, he would have learned that some of the plants
he ate have soothing effects against some ailments. This knowledge about the soothing
effect of plants—what we call today as medicinal property—gathered through life, compiled
verbally, and transmitted on orally to the successive generations. Later, those persons
who dedicated their life for discovering more and more new beneficial plants as a remedy
for various diseases codified their informations into treatise form [1, 2].

On going through the sacred Vedas, which were written around 3500 B.C., and
800 B.C., many citations on the importance of medicinal plants can be found. One of the
oldest and famous Indian literatures ‘Rig Veda’ describes the use of Cinnamon, Ginger,
Sandalwood and others, for religious as well as medicinal purposes [3].

Medicinal plants, with few exceptions are indigenous and are restrictedly
distributed in an area. However, their demand in the world pervaded rapidly. Therefore,
medicinal plants are considered as local heritages with global importance. World is
enriched with a huge number of medicinal plants, but the medicinal properties of most of
them are unidentified. Reports indicate that more than 70,000 plant species have been
used for medicinal purposes, at one time or another. About 5,700 traditional medicines of plant origin are recognized and classified in the Chinese Pharmacopoeia [4]. Ayurveda, one of the globally recognized branch of medicine rooted in India, have already identified more than 2,000 medicinally relevant plant species. According to an all India biological survey carried out by Ministry of Environment and Forests-Government of India, the people of India are using more than 8,000 species of medicinal plants [1].

World Health Organization’s (WHO) report shows that even today, more than 80% of the populations of the developing countries are using folk medicines for their primary health needs. This is due to their knowledge regarding the magical power of medicinal plants to protect life [5, 6]. Studies indicate that 25% of the drugs listed in modern pharmacopoeia are derived directly from plants while others are synthetic drugs, but are mainly synthesized based on natural compounds isolated from plants. Importance of plant-derived medicine is increasing in the world due to the following reasons; (a) they are non-toxic and are having least or no side effects, (b) are having multiple health protecting effects, and (c) are available at cheaper rate [7].

1.1 Importance of medicinal plants in India

In our traditional systems of medicine such as Unani, Ayurveda and Siddha, 95% of the medicines are extracted from plants and are used in crude form [8]. Indian people are mainly depending on plant-based medicine for a wide range of health related applications. In Ayurveda, many formulations based on whole plant or plant parts are used against anemia, asthma, arthritis, chronic constipation, chronic fever, cough, cysts, dental diseases, gastritis, high blood pressure, intestinal worms, epilepsy, leucorrhoea, leucoderma, obesity, paralysis, urinary tract infections, sexual debility, skin disorders,
tumors etc [9]. India is one of the countries with a rich genetic diversity of medicinal plants. Medicinal plants have significant role in the life of Indians. In the past (or even today), some of the Indian population worshiped some medicinal herbs. Through centuries, Indian’s have developed a culture to discover, protect, propagate and inherit the knowledge of medicinal plants. Indian’s life in relation to medicinal plants is of great relevance because it not only helps to ensure the health and the economy of millions of people of India but the entire world also.

1.2 Advantages of plant medicines over synthetic drugs

Plant derived medicines are safer and better for human health than synthetic drugs. The anatomical and physiological construction of human body is well suited for digesting and utilizing plant based foods. An interesting point is that human body can simultaneously use a product as medicine as well as food. For example, lemons, papayas, onions and oats serve as food or medicine or as both. Lemon helps to defend microbial infection, papaya helps to expel worms, onion relieves bronchial infections and oats support convalescence [4]. Plant compounds have the ability to do the same function in human body as in plants. The main advantage is that these compounds may not develop as a toxin to animal cell, because of the fact that the cytological machinery of a plant and animal cell is similar in many ways. For example, natural antioxidants in plant protect plant cells from oxidation, and often perform the same function in the human body. Human body has the ability for metabolizing plant materials rather than recognizing it as a foreign body. Synthetic drugs lack the above properties. Therefore, they may act in the body as irritants, toxins or as organ damaging agent. Some of the important advantages of the plant compounds over synthetic drugs include, (i) least or no side effects on the
physiological activities of the body, (ii) synergistic or multiple health promoting actions, and (iii) easy to absorb and distribute in the area of infection [10, 11].

1.3 The medicinal properties of plants are due to Secondary metabolites

Medicinal properties of plants are due to the presence of several complex chemical substances commonly known as secondary metabolites or natural products. They are stored in cell sap of one or more plant parts. According to their chemical nature, they are grouped as alkaloids, glycosides, corticosteroids, essential oils etc. They are called secondary metabolites because they have no direct function in the growth and development of the plant as that of the primary metabolites. However, many of them have important ecological and physiological functions. Some of them are; a) as a protection agent against herbivory and microbial infections, b) as an attractant for pollinators and seed dispersing animals, c) as an agent of competition between plants, d) as an agent for protecting the plant body from UV rays, e) as a signal compound within the plant etc.

Many secondary metabolites have antimicrobial, insecticidal and various pharmacological properties because of their ability to interact with nucleic acids or proteins of the target cell [12, 13]. In medicine, they are important therapeutic tools in several relevant clinical areas such as neurodegenerative diseases, cardiovascular diseases, tumor diseases, immuno-inflammatory diseases, diabetes treatments, malarial treatments and even against HIV infections [14, 15].

During the last few years, major attention has been given to the isolation of natural products for the treatment of various diseases. These bioactive, natural compounds may serve as a drug for direct use, as a starting material for the synthesis of
other drugs, or as the model for the synthesis of novel new drugs [16]. These bioactive principles may be variously distributed in different parts of the plant such as stem, root, rhizome, flower, fruit, seed, or bark; sometimes, evenly distributed throughout the plant body. Researchers may select one or several parts of the plant for studying medicinal effects.

In the present study, fruits especially that are common in Kerala were selected for studying their medicinal properties. Many fruits are enriched with one or several medicinal properties such as antibacterial, antifungal, antiprotozoal, antidiabetic, anticancer, antiviral, antipyretic, antisterility, anti-allergic, anti-inflammatory, immunomodulatory, and so on. The present study is mainly aimed to identify and evaluate the medicinal properties of common fruits of Kerala with special emphasis on antibacterial, antifungal, and antiprotozoal activities.

1.4 Scope for antibacterial studies

Among different microorganisms, bacteria constitute a major group causing a wide range of infectious diseases in man. Virulent strains of bacteria are an important cause of community and hospital acquired infections. However, one of the threats faced globally in the antimicrobial treatment is the development of resistance to drugs by these microorganisms. These drug resistances are more prevalent in hospital environment [17]. Even though more than 6,500 antibiotics are identified, only about 100 of them are commonly used in treatment, because others are toxic or have many side effects on human body. On one side, the number of effective antibiotics commercially available is limited and on the other side drug resistance by microorganisms progresses day-by day. This again resulted in acute shortage of available antibiotics [18]. To overcome this
problem, it is necessary to search for new compounds as substitute for non-effective
antibiotics. For achieving this goal, extracts of plants or their compounds have been
studied for the last few decades [19, 20, 21]. This is because of the observation that
many plants protect themselves by accumulating wide range of antimicrobial-secondary
metabolites in their body. Some are constitutive chemical barriers to microbial attack
(phyto anticipins) while others are inducible antimicrobials (phyto alexins). These
compounds are extensively studied in various parts of the world as controlling agents of
plant and human disease [22].

1.5 Scope for antifungal studies

Fungi that were non-pathogenic in early days now have developed as
opportunistic human pathogens especially in persons with immune system disorders and
the frequency of infections are found to be increasing in recent years. Fungal infections
can be either internal or external. These infections are sometimes quite difficult to cure
and some internal infections can lead to secondary illness or even organ damage. Fungal
diseases can induce allergic reactions to fungal proteins and toxic reactions to fungal
toxins. ‘Aflatoxin’, a mycotoxin produced by Aspergillus flavus is dangerous to man and
animals [23, 24]. In modern medicine, the drugs available to treat mycoses and other
fungal diseases are limited. More over, these drugs have many problems including rapid
development of resistance by pathogen, interaction problems between drugs and so on.
Thus, there is an urgent need for the development of more efficient antifungal agents with
fewer limitations, less side effects and a broad-spectrum antifungal activity [25].
1.6 Scope for antiprotozoal studies

Protozoal attack is a prime reason for increased mortality rate in tropical and sub-tropical countries [26]. Studies reveal that more than 3 billion individuals in different parts of the world are suffering from one or more protozoal diseases [27]. Even though different antiprotozoal drugs are available in modern medicine, the number of efficient and less toxic drugs is limited. To overcome this problem, efforts should be made to invent new, more efficient and safer antiprotozoal drug from natural sources.

1.7 Objectives of the present study

Investigation of antimicrobial potency of plants or its parts, like fruits, may lead to the development of new plant based drugs. Therefore, it is of great interest to carry out antibacterial, antifungal and antiprotozoal studies of fruits, in order to validate their use in modern medicine. Household fruits of Kerala, available commonly, are selected in the present study for evaluating their medicinal roles such as antibacterial, antifungal and antiprotozoal. The main aims and objectives of the present study are,

- **In vitro** screening of selected fruits for antibacterial properties using standard strains.
- Selection of fruit with highest antibacterial activity for further detailed studies including antibacterial, antifungal and antiprotozoal activities.
- Isolation and purification of antimicrobial principles from the selected fruit.
- Testing the antibacterial efficiencies of the active principles against Standard and Clinical bacterial strains, comparison with standard antibiotics and determination of its MIC.
• Testing the antifungal efficiencies of the active principles against pathogenic fungi and determination of its MIC.
• Testing the antiprotozoal efficiencies of the active principles against selected protozoa.
• Characterization of active principles by standard protocols.

1.8 Work plan

The study was conducted in the Microbiology and Biochemistry laboratories of St. Thomas College, Palai, during the period of July 2006 to January 2010. The entire work was divided into five sections, according to the progress that were made during the study period. They are 1) Preliminary antibacterial screening of fruits. 2) Antibacterial, antifungal and antiprotozoal studies with crude extracts of the selected fruit. 3) Isolation and purification of the active principles from the selected fruit and determination of its physicochemical and antibacterial properties. 4) Determining the efficiency of the purified compound against, fungi, protozoa and pathogenic bacteria. 5) Characterization of the active compound.

In the thesis, above sections are written as different chapters (chapters 3 to 7), in addition to this chapter- General Introduction (Chapter 1), Literature Review (Chapter 2) and Summary (Chapter 8). Each chapter is organized in the following sequences, Introduction, Materials and methods, Results and Discussions, Conclusion and relevant References.
1.9 References


