CHAPTER 1

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1.1. Medicinal Plants

People have gathered plant and animal resources and from a long time plants and animal products were the main source of drugs. However, knowingly and unknowingly plants have been used as a medicinal agents by mankind, since the beginning of human civilization for its therapeutic value. The major source of these medicinal agents is nature and from these natural sources, an impressive number of modern drugs have been isolated. And the bases for many of these isolations were the use of these agents in traditional medicine. About 80% of the world’s inhabitants relying mainly on tradition medicines for their primary health care and thus the plant based traditional medicine systems continue to play an essentials role in health care (Owolabi et al., 2007).

Any plant in which one or more of its organ contains substances that can be used for the therapeutic purposes or which are precursors for the synthesis of useful drugs is a “Medicinal plant” (WHO, 1977). This definition provides the information of those plants whose therapeutic properties and constituents have been scientifically established and distinguishes from the plants that are regarded as medicinal but which have not yet been subjected to thorough investigation. The term “herbal drug” determines the part/parts of a plant may be leaves, flowers, seeds, roots, barks, stems etc., which are used in preparation of medicines (Anonymous, 2007a). Furthermore, according to WHO (2001) a medicinal plant is a herbal preparations produced by subjecting plant materials to extraction, fractionation, purification, concentration or other physical and biological
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process which can be consumed immediately or can be used as a basis for herbal products.

The inherent active ingredients of medicinal plants which are used to cure disease or relieve pain (Okigbo et al., 2008). In most of the developing countries, the traditional medicines and medicinal plants are used as therapeutic agents for maintenance of good health (UNESCO, 1996). Modern pharmacopoeia contains at least 25% drugs which are derived from plants and plant derivatives, which are synthetic analogues, built on prototype compounds isolated from plants. Due to the rising cost of prescription drugs, interest in medicinal plants and bioprospecting new plant derived drugs as a re-emerging health aid has been fuelled in maintenance of personal health and well being (Lucy and Edgar, 1999). Escalating faith in herbal medicine is one of the reasons for ongoing growing recognition of medicinal plants (Kala, 2005). Furthermore, in the industrialized societies an increasing reliance on the use of medicinal plants from traditionally used herbal remedies has been traced back to the extraction and development of drugs and chemotherapeutics from plants (UNESCO, 1998). As per the report of WHO, the best source to obtain a variety of drugs is the medicinal plants. Therefore, such plants should be investigated to better understand their properties, safety and efficacy (Nascimento et al., 2000).

1.2. Importance of Medicinal Plants

For thousands of years, human beings have used plants for the treatment of diverse ailments (Sofowara, 1982; Hill, 1989). Medicinal plants are having wide
biological and medicinal activities, high safety marginal and lesser costs. In both developed and developing countries, herbal medicines are in great demand as a source of primary health care (Lai and Roy, 2004; Tapsel et al., 2006). As the major part of populations cannot afford the products of western pharmaceutical industries (Salie et al., 1996), together with their side effects and lack of healthcare facilities, rely on traditional medicines for their psychological and physical health requirements. The traditional medicines are relatively cheaper and safer than modern and synthetic medicine (Iwu et al., 1999; Idu et al., 2007). To treat all manners of illness, from minor problems to life threatening diseases, human have relied almost entirely on plants, since ancient period of time. Still large section of the people depends on traditional plant drugs for their primary health care (Akerele, 1993). Even today, in the developed countries the herbal medicine is deep rooted. This is because,

1. Since from thousands year people have been using plants for the treatment of various ailments (Sofowara, 1982).

2. Plants are the source of many potential and powerful drugs and are used medicinally in different countries (Mahesh and Satish, 2008).

3. In rural areas of many developed countries, traditional medicines play an important role in day to day life for primary health care need (Maurice et al., 1999; Mann et al., 2008).

Apart from these there are many other reasons for using medicinal plants as therapy by people. There is an erroneous belief among peoples of under developing
countries that the herbal products are more effective and superior to synthetic products. In some African communities people use the traditional medicines because they believe that these medicine help to clean out negative spiritual influences (Bagnis et al., 2004). In some developing countries many people turn to medicinal plant treatment, because the orthodox medicine is too inconvenient, not immediately available, cost or time consuming and having side effects. And also due to dissatisfactory results from synthetic drugs, people believe that herbal medicine might be more effective in the treatment of certain diseases where conventional therapies and medicines have proven to be ineffective (Gill et al., 1994).

Rural area people from their personal experience know that these traditional remedies are valuable source of natural products to maintain human health and some medicinal plants are highly effective only when used at therapeutic doses, but they may not understand the science behind these medicines (Maheshwari et al., 1986; Van Wyk et al., 2000).

The additional cultural factors in rural areas also encourage the use of botanicals such as a “man-earth” relationship, the concept of interplay between the environment and culture (Gester, 1992). The developments of science and technology with improvements in the quality, efficacy and safety of herbal medicines have also been largely responsible for the increase use of medicinal plants, (WHO, 2002, and 2005).
1.3. Phytochemicals of Medicinal Plants

The chemicals produced by the plants are classified as primary or secondary metabolites. Primary metabolites occur in one form or another virtually in all organisms and are widely distributed in nature. In higher plants, these primary metabolites are needed for physiological development because of their role in basic cell metabolism and thus are often concentrated in seeds and vegetative storage organs. Commercially the primary metabolites obtained from higher plants are high volume-low value bulk chemicals (e.g., Vegetable oil, fatty acids, carbohydrates, etc). Many secondary metabolites are generally produced by plants which are biosynthetically derived from primary metabolites. These secondary metabolites constitute an important source of microicides, pesticides and many pharmaceutical drugs. Directly or indirectly, the medicinal plants or their secondary metabolites are playing an important role in the human society to combat diseases, from a long period (Wink et al., 2005).

Secondary metabolites are frequently accumulated by plants in smaller quantities and have no apparent functions in plants metabolism. However, these secondary metabolites often have an ecological role, as pollinator attractants, represent chemical adaptations to environmental stress or even serve as chemical defense against microorganisms, insects and higher predators or even other plants (Karpuppusamy, 2009; Satishkumar paulsamy, 2009).

The bioactive compounds produced by medicinal plants are used mainly for medicinal purposes. These compounds act either through interfering in the metabolites of
infecting microbes or on different systems of animals including man. The bioactive compounds from medicinal plants play a determining role in regulating host-microbe interaction either microbe are pathogenic or symbiotic. Thus it is important to identify these bioactive compounds in plants, isolate, purify and characterize active ingredients in crude extracts by various analytical methods. The medicinal properties of plants could be based on antimicrobial, antipyretic, antioxidant effects of the phytochemicals in them (Cowman, 1999; Adesokan et al., 2008).

The extraction and purification of secondary metabolites is difficult as they are synthesized in specialized cell types and at distinct developmental stages. Commercially used and biologically active secondary metabolites are generally high value-low volume products (eg. Steroids, quinines, alkaloids, terpenoids and flavonoids), which are used in drug manufacture by the pharmaceutical industries. The molecular weight of secondary metabolites are generally less than 2000 and are obtained from plants by steam distillation or by extraction with organic or aqueous solvents. For drug synthesis and semi-synthesis, some biologically active plant compounds have found application as drug entities.

The isolated plant constituents may be used directly as therapeutic agents or as starting material or may serve as models for pharmacologically active compounds in drug synthesis. The steps involved in phytopharmacological research generally includes proper selection of medicinal plants, extraction of crude extracts, biological screening, detailed chemopharmacological investigation, toxicological and clinical studies standardization.
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and use of active moiety as the lead molecule for drug design (Wink et al., 2005). Some of the important secondary metabolites found in plants include:

**Alkaloids**

Alkaloids are naturally occurring chemical compounds produced by a large variety of organisms including bacteria, fungi, plants and animals. These contain a basic nitrogen atom and often have a pharmacological effects thus they are used as medications and recreational drugs. Many alkaloids are toxic and some have bitter taste.

**Flavonoids**

Flavonoids are commonly known for their antioxidant activities and are widely distributed in plants. These are derived from 2-Phenyl chromen-4-one (2-phenyl-1-4-benzopyrone) and perform many functions including protection from attack by microbes and insects, and producing yellow, red or blue pigmentation in flowers. Flavonoids have inherent ability to modify the body’s reaction to allergens, viruses and carcinogens, thus are referred to as natures biological response modifiers. They exhibit anticancer activity, antimicrobial, anti-allergic and anti-inflammatory activities (Rauha et al., 2000; Cushnie and Lamb, 2005; Filippos et al., 2007).

**Saponins**

Saponins are found in various plant parts such as leaves, stems, roots, bulbs, flower and fruits. They exist as glycosides of 27 carbon atom steroids, or 30 carbon atom triterpenes in plants. Saponins are believed to be useful in the human diet for controlling cholesterol, and are characterized by their bitter taste and their ability to haemolyze red
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Blood cells. They are medically used as expectorant, emetic and for the treatment of excessive salivation, epilepsy, chlorosis and migraines. In Ayurvedic medicine saponins are used for the treatment of eczema, psoriasis, for removing frackles and strengthen the heart muscle causing the heart to pump more efficiently (Oakenfull and Sidhu, 1990). Saponins also inhibit cancer tumor growth in animals, particularly lung and blood cancers, without killing normal cells. They act as an antibiotic to protect the plant against microbes and fungus, thus they are known as plants defensive agents (Shideler, 1980; Chatterjee and Chakravorty 1993).

**Anthraquinones**

Anthraquinones are aromatic organic compounds naturally occurring in some plants, fungi, lichen and insects. These are the derivative of anthracene and fairly stable under normal conditions. It has the appearance of a yellow or light gray to gray-green, solid, crystalline powder. Anthraquinones are used in the production of dyes as it serves as a basic skeleton for pigments and are also used as a laxative (Chatterjee and Chakravorty, 1993; Samp, 2008).

**Cardiac glycosides**

Cardiac glycosides are found as secondary metabolites in several plants and in some animals. These are the drugs used in treatment of congestive heart failure and cardiac arrhythmia. Some of these are used in hunting as arrow head poisons (Filippos et al., 2007).
1.4. Indian Medicinal System

India has a vast geographical area which has a rich flora of medicinal herbs and spices with high potential abilities which includes about more than 2000 species as described in Ayurvedic, Unani and Siddha traditional medicinal systems but only very few have been studied for their potential medicinal value chemically and pharmacologically (Gupta et al., 2005; Sandhu and Heinrich, 2005).

1.5. Recent Development of Nature Drugs

According to conservative estimate there are about 2, 50,000 of flowering plants occurring on the earth planet, of which only 6% have been screened for biological activity and 15 % of them have been evaluated phytochemically. However, from 94 species of plant, a total of 122 biologically active compounds have been derived and identified. To discover a probable abundance of medicinal extracts in these plant consistent findings should be carried out (Turker and Usta, 2008). In most developing countries, the use of traditional medicine and medicinal plants as a normative basis for maintenance of good health has been widely observed (UNESCO, 1996). The development of several drugs and chemotherapeutics in the industrialized societies has been traced to the traditional use of medicinal plant and rural herbal remedies (UNESCO, 1998).

The pharmaceutical research and development committee report of Ministry of chemicals, Government of India also underscores the importance of traditional knowledge (Mashelkar, 1999). The increasing reliance on the traditional therapies
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demands more scientifically found evidence for the principles behind such therapies for effectiveness of medicines. In validation of these therapies, recent advances in the analytic and biological sciences along with innovation in genomics and proteomics play an important role (Patwardhan et al., 2003; Fabricant and Farnsworth, 2001).

Rapid pace of research and development in herbal medicine has made it an interdisciplinary science. The scientific monograph of any medicinal plant concludes the knowledge of alternative complementary systems of medicines like Ayurveda, botany, pharmacognosy and phytochemistry, biochemistry, ethanopharmacology and toxicology are integral part of herbal medicine. Recently there has been an explosive growth of herbal drug industry. And as per the data it is analyzed that more and more people are consulting the herbal medicine practitioners. The importance of herbal medicine has been identified by WHO and the recent US study shows that, in rural areas about 60-70% patients are dependent on herbal medicine for the remedy of day to day diseases. Most of the researchers have reported favorable results with herbal drugs (most in the form of extracts) either in animals or in human studies (Padma, 2005).

1.6. Role of World Health Organization in Phytomedicine

Two decades ago, WHO referred as “Holistic” to traditional health system – In the view that man is totally with in a wide ecological spectrum and emphasizing the view that health or disease is due to imbalance or disequilibrium of man in his total ecological system and not only by causative agent but also by pathological evolution (WHO, 1978). The general mission of WHO is to improve health and save lives by essential drugs and
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medicinal policy. The WHO policy have offered potential essential drugs to the millions of people particularly the poor and disadvantaged group to whom medicines are unavailable, unsafe or improperly used. It does this by carrying out a number of core functions: Articulating policy and advocacy positions, working in partnership, producing guideline and practical tools, developing norms and standards, stimulating strategic operation research, developing human resources and managing information (WHO, 2002b). The legal process of regulation of herbal medicines changes from country to country mainly because of cultural aspects and also the fact that herbal medicines are rarely studied scientifically. In order to define basic criteria for evaluating the quality, safety and efficacy of herbal medicines, WHO has published guidelines aimed at assisting national regulatory authorities, scientific organization and manufacturer in this particular area (Akerele, 1993).

**Salient feature of WHO guidelines:**

1. Quality assessment – Crude plant material or plant extract preparation and finished product.


3. Safety assessment: Documentation of safety based on experience or/and; Toxicology studies.

4. Assessment of efficacy: Documented evidence of traditional use and; Activity determination (animals, human).
1.7. Traditional Medicine and Complementary Alternative Medicine

According to world health organization (WHO) traditional medicine is a diverse health practices, approaches, knowledge and beliefs incorporating plant, animals or mineral based medicines, spiritual therapies, manual techniques, exercises to maintain well being, as well as to treat, diagnose or prevent illness (WHO, 2002a).

Traditional medicine is a comprehensive term used to refer both systems such as traditional Chinese medicine, Indian ayurvedic or Arabic Unani medicine and to various other indigenous medicines. In many countries traditional medicine is often termed as “complementary”, alternative or non conventional medicine, where the allopathic medicine is not a dominant health care system or where traditional medicine has not been incorporated into the national health care system (WHO, 2002a; Alves and Rosa, 2006).

1.8. Traditional Medicine and Pharmaceuticals

Despite the belief that majority of clinical drugs are synthetic in origin, over 50% of the top 20 drugs could be linked to natural product research and it is also interesting to note that 6 out of top 20 pharmaceutical prescription drugs dispensed in 1996 were natural products (Phillipson, 2001). The world market in 1997 was estimated for over the counter phytomedicine product was US$ 10 billion with 6.5% of annual growth. Among the drug prescribed across world, it is estimated that about 25% of drug come from plant origin. World health organization stated that out of 252 basic and essential drugs used currently, 121 active compounds are from natural products, 11% are exclusively of plant origin and a significant number of synthetic drugs are obtained from natural precursors.
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(Rates, 2001). In globally used allopathic medicine, about 119 drugs of known structure are extracted from plants were commercially produced from less than 90 species of higher plants (Farnsworth, 1990).

The majority of the natural origin molecules cannot be synthesized economically and thus still obtained directly from wild or cultivated plants and it is estimated that about 60% antitumors and anti-infectious drugs which are already in market or under clinical trial are obtained by plants (Rates, 2001).

Isolation of antimalarial alkaloids, cardiotonic glycosides, anticancer agents etc., from plants is the significant agents from natural products and is important for the benefit of mankind. As per the survey of current pharmaceutical preparation, 25% out of total prescription drugs dispensed are plant derived (Farnsworth and Morris, 1976; Ogundipe et al, 1998). The isolated plant compound varies highly in their structure; many are aromatic substances, most of which are phenols or their oxygen-substituted derivatives. However, due to the side effects and resistance of pathogenic micro-organisms against the antibiotics, there is an increased attention on extracts and biologically active compounds isolated from plants species used in herbal medicine. (Essawi and Srour, 1999).

New compounds like benzoin and emetine have been isolated from plants, which inhibit the growth of micro-organisms (Cox, 1994). Aspirin, atropine, ephedrine, digoxin, morphine, quinine, reserpine and tubocurarine are the various pharmaceuticals used in modern medicine which serve as examples of drug discovered through
observation of indigenous medical practices (Gilani and Rahman, 2005). Eloff (1999) stated that the antimicrobial compounds isolated from plants have clinical value in the treatment of resistant microbial strains, which may inhibit bacteria by different mechanism than the presently used antibiotics.

In the important fields particularly in anticancer and antimalarial there is a rewarding progress of good number of novel plant derived substances that have entered into western drug markers and clinical plant based research (De smet, 1997). Thus many medicinal plants are serving as sources of therapeutic agents and many of the existing drugs are derived directly or indirectly from higher plants, they may act as raw materials for the manufacture of more complex compounds or models for new synthetic products and as taxonomic markers (Akerele, 1993). In recent years, many of plant drugs have gained a new investigational or therapeutical status and several have lost much ground to synthetic competitors. (De Smet, 1997). In addition to all the above mentioned facts, there is a rapidly growing demand for traditional herbal drugs as alternative therapeutic means in industrialized countries and thus constitute the extensive practice of traditional medicine in international relevancy of research and development. To integrate the potential of traditional herbal medicine into current practices of modern health care, an additional motivation for such activities is found in the practice.

1.9. Need of the Hour

Plants are a source of many potent and powerful drugs and are used medicinally in different countries (Srivastava et al., 1996). Unfortunately, the instant rising in the
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Demand of plant-based drugs is creating heavy pressure on some of the selected high value medicinal plants populations due to over harvesting. Many of these medicinal plant species have narrow geographic range, low population densities and slow growth rates (Nautiyal et al., 2002), thus are prone to extinction (Jablonski, 2004).

Conversely, the knowledge of therapeutic plants started to decline and become obsolete through the lack of recognition by younger generations as a result of shift in attitude and ongoing socio-economic changes, because the information on the use of plant species for therapeutic purpose has been passed from one generation to next through oral tradition (Kala, 2000). Furthermore, there is a rapid decline in the indigenous knowledge on the use of lesser-known medicinal plants. Thus the continuous erosion in the traditional knowledge of medicinal plants in the past and currently renewal interest, need existed to review the valuable knowledge with the expectation of developing the medicinal plants sector (Kala et al., 2006). Large number of plants or plants product based medicines and the determination of their morphological and pharmacological or pharmacognostical characters have been described in Indian ayurvedic systems which provides better understanding of their principles and mode of action. However, the chemical constituents, pharmacological properties of the extracts and their pharmacognostical characterization of tropical plants have not been studied in detail.

Therefore, the best way to learn about potential future medicines is by traditional use of medicine. Number of compounds has been identified by researchers used in
mainstream medicine which were derived from ethnomedical plant sources (Fabricant and Farnsworth, 2001). Hence the present study is aimed for phytochemical screening and pharmacological activities on *Rumex vesicarius* Linn. belonging to the Polygonaceae family.

1.10. **Polygonaceae family**

Polygonaceae is a family of flowering plants, informally it is known as the knotweed family or smartweed family. The name is based on the genus polygonum and was first used by Antoine Laurent de Jussieu in 1789 in his book, Genera Plantarum (Antoine, 1789). The name refers to the many swollen nodes that are present on the stems of some species. It is derived from Greek; poly means many and goni means knee or joint.

Polygonaceae comprises about 1200 species (David, 2008). These are distributed into about 50 genera. The largest genera are *Eriogonum* (240 species), *Rumex* (200 species), *Coccoloba* (120 species), *Persicaria* (100 species) and *Calligonum* (80 species) (Craig and James, 2005; John, 1993). These families are found worldwide, but are most diverse in North Temperate Zone. Polygonaceae contains some of the worst weeds. These include species of *Persicaria, Emex, Rumex*, and *Polygonum* (David, 2008).
Classification

Kingdom- Plantae
Phylum- Mangoliophyta
Class- Mangoliopsida
Order- Caryophyllales
Family- Polygonaceae
Genus- Rumex
Species- Rumex vesicarius L.

Common Names

English - Bladder dock, Rosy Dock, Dock Sorrels
Hindi - Chukka ki bhajji
Kannada - Hun chi pallya
Bengali - Takpalong, Chukapalong

1.11. Rumex vesicarius L.

Rumex vesicarius L. is a branched succulent herb belongs to the family Polygonaceae and is distributed widely in India. It is one of green vegetable medicinally valuable plant and it is commonly called as “Bladder dock”. Rumex vesicarius L. is a wide edible plant used as a sorrel and collected in spring time and eaten fresh (Batanouny, 1999), or cooked form (Al-Quar, 2009).

Rumex vesicarius L. plants are erect, usually with long tap roots bearing fleshy to leathery leaves form a basal rosette at the root. The basal leaves may be different from
Fig. 1 Showing *Rumex vesicarius* L.
those near the inflorescence. They have minor leaf veins but may or may not have stipules. The leaf blade margins are entire or crenate (Fig. 1).

The plants have inconspicuous flowers which are green and situated above the leaves in clusters. Fertile flowers are mostly hermaphrodite or they may be functionally male or female. The flowers and seeds grow on long clusters at the top of a stalk emerging from the basal rosette. Each seed is a 3-sided achene, often with a round tubercle on one or all three sides (Peter, 2001).

1.12. Medicinal importance of *Rumex vesicarius* L.

*Rumex vesicarius* L. has many important medicinal uses as per the traditional knowledge, it is used in the treatment of tumors, hepatic diseases, bad digestion, constipation, calculus, heart troubles, pains, diseases of the spleen, hiccough, flatulence, asthma, bronchitis, dyspepsia, piles, scabies, leucoderma, toothache and nausea. The plant is also used as cooling, laxative, stomachic, tonic analgesic, appetizer, diuretic, astringent, purgative, antispasmodic and antibacterial agents. The roasted seeds were eaten for cure of dysentery and finally, the plant can also be used to reduce biliary disorders and control cholesterol levels (Elegami et al., 2001, Atiqur et al., 2004, Abutbul et al., 2005, Lakshmi et al., 2009). The medicinal importance of this plant is a reflection of its chemical composition since the plant contains many bioactive substances such as flavonoids and anthraquinones. The plant also contains carotenoids, vitamins, proteins, lipids and organic acids and it is a good source of minerals (Saleh et al., 1993, AL-Rumaih et al., 2002). The intake of these dietary phytochemicals by the consumption of
vegetable *Rumex vesicarius* L. will lead to the immunization against non communicable diseases in human beings and also are good antibacterial agents against many human pathogenic bacteria.

**1.13. Aim and Objectives of the present studies:**

1. Pharmacognostic studies of *Rumex vesicarius* L.


3. Extraction, isolation, purification and identification of bioactive compounds.

4. Pharmacological screening of methanolic extract and isolated biactive compound of *Rumex vesicarius* L.