INTRODUCTION
Nature has provided a complete store house of remedies to cure the countless ailments of mankind. The knowledge of drugs has accumulated over thousands of years, as a result of man's inquisitive nature, so that we possess many effective means of ensuring health care. Today, a vast store of knowledge concerning the therapeutic properties of different plants has been accumulated. Plants have an almost limitless ability to synthesize aromatic substances, mainly secondary metabolites, of which at least 12,000 have been isolated, a number estimated to be less than 10% of the total. In many cases, these substances serve as the molecules of plant defense against predation by microorganisms, insects and herbivores. Further, secondary metabolites of some plants may be involved in plant odour (terpenoids), pigmentation (tannins and quinines) and flavour (capsaicin). However, several of these molecules possess medicinal properties (Cowan, 1999).

Herbal medicine has been practised worldwide and now it is recognized by WHO as an essential building block for primary healthcare (Onayade et al., 1990). Different people in different areas named their systems of medicine according to their experience, wisdom and knowledge. In India, we have three major traditional systems of medicine known as Ayurveda, Siddha and Unani. Ayurveda, the Indian indigenous system of medicine, dating back to the Vedic Age (1500-1800 BC) has been an integral part of the Indian culture and tradition. The origin of Siddha system of medicine can be traced back from the days of sangam period.

The earliest mention of the use of plants in medicine is found in the Rigveda, which was written between 4500 and 1600 BC. In recent times, focus on plant research has increased all over the world and a large body of evidence has been collected to show the immense potential of the medicinal plants used in various traditional systems (Ayurveda, Siddha and Unani). Medicinal plants are assuming greater importance in the primary health care of individuals and commu-
nities in many developing countries. There has been an increase of demand in international trade. This is because herbal medicines are very effective and easily available. They produce no effects. They are used as alternatives to allopathic medicines. The basic idea is to use medicinal plants to develop the standardized phytomedicines (phytotherapics or herbal medicine) with proved efficacy (assessed by both pre-clinical and clinical studies), safety and high quality. In contrast to the several millions of dollars and several years of research needed to develop a new drug by synthesis, or even from the prototype of a natural source, the development of standardized phytomedicines demands considerably lower funds and seems to be perfectly feasible in underdeveloped countries (Calixto, 2000).

The medicinal value of plants lies in some chemical substances that produce a definite physiologic action in human body. The most important of these bioactive compounds of plants are alkaloids, flavonoids, tannins and phenolic compounds. The phytochemical research based on ethno-pharmacological information is generally considered an effective approach in the discovery of new anti-infective agents from higher plants (Duraipandiyan et al., 2006). Knowledge on the chemical constituents of plants is desirable, not only for the discovery of therapeutic agents, but also because such information may be of value in disclosing new sources of such economic materials as oils, gums and precursors for the synthesis of complex chemical substances. In addition, the knowledge on the chemical constituents of plants would further be valuable in discovering the actual value of folkloric remedies (Mojab et al., 2003). Out of the total 4,20,000 flowering plants reported from the world (Govaerts, 2001) more than 50,000 are used for medicinal purposes (Schippmann et al., 2002). In India, more than 43% of the total flowering plants are reported to be of medicinal importance (Pushpangadan, 1995).

The family Amaranthaceae is pantropical in distribution. A plant belonging to this family is found in plenty in pastures or meadows, wastelands and roadsides throughout India as a weed.
Considering the medicinal value of Amaranthaceae, it is in very great demand and is vastly used in ayurveda and sometimes in modern pharmaceutical products. Amaranthaceae is regarded as acrid, astringent, pectoral and diuretic. The dried plant is used as a laxative, and is in great demand for the treatment of gonorrhoea and colic. It is also useful for the treatment of renal dropsy. In large doses, however, it acts as an ecbolic.

There are approximately 28 species of Aerva genus, but only a few species are medicinal of which A. persica, A. lanata and A. javanica are of great value. Aerva plants are used to cure ulcer, lithiasis, dropsical affections, eye affection, toothache, headache, in disorders of abdomen and inflammation of internal organs. Roots and flowers are reported to possess hypoglycemic, antioxidant, anthelminthic, analgesic, antimalarial, antivenom activities and medicinal properties against rheumatism and kidney troubles.

1. **Scientific Classification of Aerva lanata**

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Binominal name: *Aerva lanata* (Linn.) Juss.ex Schult.
1.1 Name of the plant in different languages

Tamil : Ciru-pulai
Hindi : Gorakhtuti, Kapuri jadi
Malayalam : Cherula, Cherupula
Telugu : Pinde-conda
Sanskrit : Bhadra
Bengali : Chaya
Kannada : Bilesuli

1.2 Description of the plant and its medicinal uses

*Aerva lanata* is a semi erect, highly branched shrub grows upto 50 cm in height. Leaves are simple, alternate, short petioled, tomentose, round to elliptic, usually covered with woolly hairs. The leaves become smaller in the flowering twigs. Flowers are small sessile, greenish or whitish, often found in spikes or dense clusters, resembling cream or greenish white wool. Fruits are greenish round compressed utricles, with kidney shaped and small seeds. Young stems are covered with soft hairs. The flowers are 1 to 1.5 inches long. The herb is cultivated throughout India, Ceylon, Arabia, Tropical Africa, Java and Philippines. *A. lanata* is one of the 10 auspicious herbs that constitute the group Dasapushpam (‘ten flowers’). *A. lanata* is an important medicinal plant, used in Ayurveda, Siddha, and Unani in folk medicine for treating several ailments including microbial infections, diarrhoea and diabetes. Plant pacifies vitiated pitta, urinary infection, vesical calculi, cough, and boils. It occurs throughout tropical India as a common weed in fields and wastelands. Because of its utilization in folk medicine, *A. lanata* has become the subject of bottomless pharmacological and chemical studies for the last 30 years. Various studies have verified its versatile pharmacological activities: antihelmintic, demulcent (Krishnamurthi, 2003), anti-inflammatory (Pullaiah and Naidu, 2003), diuretic (Vertichelvan et al., 2000), expect-
torant, hepatoprotective (Udupihlle and Jiffry, 1986), nephroprotective (Manokaran et al., 2008), anti-diabetic activity, anti-hyperglycaemic activity in rats (Shirwaikar et al., 2004; Vetrichelvan and Jegadesan, 2002), anti-microbial, cytotoxic (Deshmukh, 2008), urolithiatic (Dulaly, 2002), hypoglycemic, anti-hyperlipidaemic (Appia Krishnan et al., 2009), anti-parasitic, (Anantha et al., 2010) and antioxidant activities (Muthukumaran et al., 2011; Ragavendran et al., 2012; Arthi et al., 2012). In order to identify the bioactive compounds responsible for the above pharmacological activities, phytochemical studies have been carried out by several workers with the report of different kinds of bioactive compounds particularly alkaloids such as: canthin-6-one and beta-carboline, aervine (10-hydroxycanthin-6-one), methylaervine (10-methoxycanthin-6-one), aervoside (10-ß-Dglucopyranosyoxyxanthin-6-one) and aervolanine (3-(6-methoxyz-l-carbolin-1-yl) propionic acid) from the leaves of A. lanata (Zapesochnaya, 1992). Muthukumaran et al., (2011), Ragavendran et al., (2012) and Arthi et al., (2012) studied the antioxidant property of A. lanata using the aerial parts.

Standardization of herbal drugs means a systemic approach to quality control. Almost in all the systems of traditional medicine, the medicinal plants play a major role and constitute the backbone for the same. In order to make sure of the safe use of these medicines, a necessary first step is the establishment of standards of quality, safety and efficacy. To ensure reproducible quality of herbal products, proper control of starting material is utmost essential. The first step towards ensuring quality of starting material is authentication. Thus, in recent years there has been a tremendous advance rapid increase in the standardization of selected medicinal plants of potential therapeutic significance (Reddy et al., 1999; Venkatesh et al., 2004).

A biomarker, on the other hand, is a group of chemical compounds which are in addition to being unique for that plant material also correlates with biological efficacy. So, the need arises for laying standards by which the right material could be selected and incorporated into the for-
mulation. A number of scientific documentations are available on crude drug extracts, promoting these herbal drugs in international / national markets. It is difficult due to lack of reproducible biological reports, selection of wrong plants and lack of data on the time and area of collection and identity of the botanical source. In certain cases, confusion exists in the identity of the source material where the origin of particular drug is assigned to more than one plant, sometimes having different morphological and taxonomical characters. Analytical methods, development and validation play an important role in the discovery, development and manufacture of pharmaceuticals. Significant exo-morphology, histo-morphology and physicochemical evaluation of the leaf, stem and micro-morphological studies of *A. lanata* have been worked out. However, the comparative phytochemical profile and pharmacological activities of individual parts of *A. lanata* have not been clearly studied.

Plants are significant sources of secondary metabolites with various remarkable biological activities. In general, these secondary metabolites are important sources with a wide variety of structural arrangements and properties (De-Fátima *et al.*, 2006). Plant products and their modified derivatives have been recorded as rich sources, with reference to therapeutic applications for more than thousands of years. Even today, about 80% of the world’s population relies predominantly on plants and plant extracts for health care (Werkaa *et al.*, 2007). There is a growing interest in correlating the phytochemical constituents of a medicinal plant with its pharmacological activity (Prachayasittikul *et al.*, 2008; Turker and Usta 2008; Hasan *et al.*, 2007). Screening of active compounds from plants has led to the discovery of new medicinal drugs which have efficient protection and treatment roles against various diseases (Mukherjee *et al.*, 2007). Natural products from microbial sources have been the primary source of antibiotics, but with the increasing recognition of herbal medicine as an alternative form of health care, the screening of medicinal plants for active compounds has become very significant because these may serve as
talented sources to create antibiotic prototypes (Meurer-Grimes et al., 1996; Koduru et al., 2006). It has been shown that *in vitro* screening methods could provide the required preliminary observations necessary to select crude plant extracts with potentially useful properties for further chemical and pharmacological investigations (Mathekaga and Meyer, 1998).

1.3 High Performance Thin Layer Chromatography (HPTLC)

At present, the chromatography is the main tool used to identify the adulterants from the medicinal materials and extract products based on the chemical profile. It is well known that the medicinal materials comprise hundreds of components, and produce their curative effects through mutual effects of many ingredients. So the limited number of specific components cannot reflect the real qualities of the herbal medicines. Therefore, an effective and inexpensive analysis method to entirely monitor the whole constituents of the medicinal materials and their corresponding extract products is required (Liu et al., 2006).

The well developed quality standards can be achieved only through systematic evaluation of the plant material using modern analytical techniques including chromatographic ones. TLC and HPTLC are methods commonly used for the identification, assay and the testing of purity, stability, dissolution or content uniformity of raw materials and formulated products (Szepesi, 1993). Finger print analysis by HPTLC has become an effective and powerful tool for linking the chemical constituents profile of the plants with botanical identity and for the estimation of chemical and biochemical markers (Patil et al., 2010; Ramya et al., 2010; Sharma et al., 2010).

1.4 Fourier Transform Infrared (FTIR) Spectroscopy

Chemotaxonomy has strongly inclined the entire field of biology, which is also useful for plant systematics. Fourier Transform Infrared (FTIR) Spectroscopy is a rapid, non-invasive, high resolution analytical tool for identifying types of chemical bonds in a molecule by producing an infrared absorption spectrum that is like a molecular fingerprint (Griffiths and de Haseth, 1986).
FTIR has been shown to be a valuable tool for differentiating, classifying and discriminating closely related microbial strains, plants and other organisms (Lu et al., 2004; Lamprell et al., 2006; Rebuffo et al., 2006; Janakiraman et al., 2011).

1.5 Gas Chromatography Mass Spectrometry (GC-MS)

In the last few years, gas chromatography mass spectrometry has become firmly established as a key technological platform for metabolite profiling in both plant and non plant species. At present, only a limited number of plant research laboratories have access to GC-MS instrumentation. However, such machines are increasingly becoming more common place (Fiehn, 2002; Sumner et al., 2003; Fernie et al., 2004; Kell et al., 2005; Robertson, 2005). Analysis of small amounts of chemicals has become easier and more cost-effective owing to the development of hyphenated chromatographic techniques such as GC or LC-MS. GC-MS analysis can identify pure compounds present at less than one nanogram (Liebler et al., 1996).

1.6 Antimicrobial activity

Medicinal plants have long been prescribed in traditional medicine for treating various diseases such as malignancies and infections. During these last decades, researchers have begun to explain these virtues by the ability of plants to limit infections (Ulanowska et al., 2006; Kuster et al., 2009), prevent lipidic peroxidations (Yamanaka et al., 1996) and their associated diseases (Rein et al., 2000; Martin and Andriantsitohaina, 2002), prevent some cancers (Ames et al., 1995) and cure allergies (Park et al., 2008). Among all these virtues, the anti-infectious activity was considered as one of the most important activities. Considering the vast potentiality of plants as sources for antimicrobial drugs with reference to antibacterial and antifungal agents, a systematic investigation has been undertaken to screen the antibacterial and antifungal activity of A. lanata.
1.7 Antioxidant study

Free radicals produced during aerobic metabolism in the body can cause oxidative damage of amino acids, lipids, proteins and DNA (Gutteridge, 1995; Halliwell, B.1995). It has been established that oxidative stress is the major causative factors in the induction of many chronic and degenerative diseases including atherosclerosis, ischemic heart disease, ageing, diabetes mellitus, cancer, immunosuppression, neurodegenerative diseases and others (Devasagayam et al., 2004; Gulcin, 2002; Buyukokuroglu et al., 2001). The most effective way to eliminate free radicals which cause the oxidative stress is with the help of antioxidants. Moreover, knowledge and application of such potential antioxidant activities in reducing oxidative stresses in vivo has prompted many researchers to search for potent and cost-effective antioxidants from various plant sources (Park and Pezzuto, 2002; Zi et al., 1997; Liu and Ng, 2000; Hu and Kitts, 2000; Chiang et al., 2004; Wang et al., 2002; Lin et al., 1999a).

Compounds responsible for antioxidant activity can be isolated and used for prevention and treatment of free radical-related disorders (Middleton et al., 2000; Klipstein-Grobusch et al., 2000; Govindarajan et al., 2005). Therefore, at recent times, attention has increased to find naturally occurring antioxidants for use in food or medicine to replace synthetic antioxidants, which are being restricted due to their carcinogenicity (Velioglu et al., 1998).

Recently, there has been a considerable interest in finding natural antioxidants from plant materials to replace synthetic ones. Natural antioxidant substances are presumed to be safe since they occur in plant foods, and are seen as more desirable than their synthetic counter-parts. Data from both scientific reports and laboratory studies show that plants contain a large variety of substances called “plant chemicals” or “phytochemicals” that possess antioxidant activity (Pratt, 1992). Natural antioxidants occur in all higher plants, and in all the parts of the plant (wood, bark, stems, pods, leaves, fruits, roots, flowers, pollen, and seeds). Therefore, to increase the in-
take of antioxidants fruits and vegetables, which are rich in these nutrients that lower the risk of chronic health problems associated with the diseases are strongly recommended (Moeller et al., 2000; Morris et al., 1998; Slattery et al., 2000).

1.8 Cytotoxic activity

The in vivo lethality in a simple zoological organism, such as the brine shrimp lethality test (BST), developed by Meyer et al., (1982), might be used as a simple tool to guide screening and fractionation of physiologically active plant extracts. One of the simplest biological responses to monitor is lethality, since there is only one criterion: either dead or alive. However, it has been demonstrated that BST correlates reasonably well with cytotoxic and other biological properties (Price et al., 1987). Brine shrimp has been previously utilized in various bioassay systems (Saifullah and Azam 2011; Keawpradub et al., 2005; Biswa and Nazmul 2012). There have been many reports on the use of this animal for environmental studies (Kumbhare et al., 2012) and screening for natural toxins (Harwig and Scott, 1971). The assay is considered a useful tool for preliminary assessment of toxicity (Solís et al., 1993) and it has been successfully used for studying plant extract toxicity (Harwig and Scott, 1971), teratology screens (McLauglin et al., 1991) cytotoxic compounds (Martínez et al., 1998; Jaki et al., 1999; Barahona and Sánchez, 1999; Pelka et al., 2000; Migliore et al., 1997) antimalarial compounds (Perez et al., 1997) insecticidal compounds (Oberlies et al., 1998) and antifeedent compounds (Labbe et al., 1993). Brine shrimp bioassay has good correlation with the human solid tumour cell lines (Anderson et al., 1991).

1.9 Anti Inflammatory Activity

1.9.1 Anti Platelet activity

Platelets are known to play a vital role in blood haemostasis (Elzey et al., 2005). Activation of blood platelets plays a crucial role not only in haemostasis but also in pathological devel-
opment of several arterial disorders, including strokes and myocardial infarction (Kroll and Schafer 1989; Duttaroy et al., 1991; Duttaroy 2002). The normal haemostatic system limits blood loss by regulated interactions between components of vessel wall, circulating blood platelets and plasma proteins (Saengkhae et al., 2008). Platelets can adhere to the walls of the blood vessels, release bioreactive compounds and aggregate to each other. These properties increase to a well established level in conditions of arterial thrombosis and atherogenesis (Guyton and Hall, 2000). Anti-platelet agents are therefore considered as a significant tool in the treatment and/or prevention of cardiovascular thrombotic diseases (DeMeyer et al., 2008). Therefore, today, the research is oriented towards the discovery of new compounds that can inhibit platelet aggregation reversibly and without any side effect.

1.10 Antidiabetic Activity

Diabetes mellitus is a serious chronic syndrome that is a major source of ill health worldwide. This metabolic disorder is characterized by hyperglycemia and disturbances of carbohydrate, protein and fat metabolisms, or relative lack of the hormone insulin (Kameswararao et al., 2003). According to WHO, the prevalence of diabetes is likely to increase by 35%. Currently, there are over 150 million diabetic patients worldwide and this is likely to increase to 300 million or more by the year 2025. Statistical reports about India suggest that the number of diabetics will rise from 15 million in 1995 to 57 million in the year 2025, the highest number of diabetics in the world (Satyanarayana, 2006).

In India, a large number of plants are mentioned in ancient literature (Ayurveda) for the treatment of diabetic conditions. Medicinal plants like Andrographis paniculata, Azadirachta indica, Ocimum sanctum, Trigonella foenum-graecum, Swertia chirayita, Pterocarpus marsupium, Aegle marmelos, Heliotropium zeylanicum, Puntia ficus, Caralluma attenuata, Salacia reticulata, Raphanus sativus and Amarathus spinosus have been studied for the treat-
ment of diabetes. However, a detailed study on the efficacy, mechanism of action and safety of plant extracts are needed (Patwardhan, 2004; Mukherjee and Wahile, 2006; Kokate, 1997).

1.11 In vitro Hemolytic Assay

Toxicity of the active molecule is a key factor during drug designing, and hemolytic activity represents a useful starting point in this regard. Phytochemicals from medicinal plants serve as lead compounds in drug discovery and design. It is seen from the recent epidemiological studies that various phytocompounds e.g., polyphenols, flavonoids, vitamin C are correlated with reduced risks of fatal and chronic diseases (Mamta and Jyoti, 2012). The hemolytic activity of the extracts was also performed to rule out the possible cytotoxic mechanism and to check the safety of the phytocompound thus making it suitable for the preparation of natural drugs. In vitro hemolytic activities are becoming a new area of research in drug lead discovery (Undas et al., 2007).

Keeping this fact in consideration, attempts were made to establish phytochemical markers / profiles for the various parts (root, stem, leaf, flower and seed) of the medicinally important plant *A. lanata* using FTIR, HPTLC and GC-MS. These profiles will help the manufacturer to identify the adulterant from the source plant.