Introduction
1. INTRODUCTION

Over the ages, humans have relied on nature for their basic needs for the production of foodstuff, clothing, shelters, means of transportation, fertilizers, flavors and fragrances, and not least, medicine. Plants have formed the basis of sophisticated traditional medicine systems that have been in existence for thousands of years in countries such as China (Chang and But, 1986) and India (Kapoor, 1990). The use of plants in traditional medicine systems of many cultures has been extensively documented. Today these plant-based systems continue to play an essential role in health care. The World Health Organization estimates that approximately 80% of the world’s populations rely mainly on traditional medicines, which are derived largely from plants, for their primary health care (Farnsworth et al., 1985). Plant products also play an important role in the health care of the remaining population, mainly in the developed countries. Analysis of prescriptions dispensed from community pharmacies in developed country like USA from 1959 to 1980 indicates that about 25% contained plant extracts or active principles derived from higher plants, and at least 119 chemical substances, derived from 90 plants species. These can be considered as important drugs that are currently in use in one or more countries of these 119 drugs, 74% were discovered as a result of chemical studies through isolation of active substances from plants used in traditional medicine (Newman and Cragg, 2000).

Natural products have played, and will continue to play, a key role in drug discovery and are therefore traditionally claimed as cornerstone of drug discovery and development (Newman et al., 2000). In fact, many drugs on the market today have been discovered from natural sources; one important example is the analgesic activity of ‘aspirin’, which is so far the world’s best known and most universally used medicinal agent; it is related to ‘salicin’, and has its origin in the plant genera *Slix* spp. and *Populus* spp.

A recent analysis of natural products as a source of new drugs over the period of 1981-2002 shows that 67% of the 877 small molecules and new chemical entities are
formally synthetic, but 16.4% correspond to synthetic molecules containing a pharmacophore derived directly from natural products. Furthermore, 12% are actually modeled on natural product inhibitors of the target of interest, or mimic the endogenous substrate (Newman and Cragg, 2003). Natural products provide a starting point for few synthetic compounds with diverse structures and often with multiple stereo centers that can be challenged synthetically (Clardy and Walsh, 2004; Nicolaou and Snyder, 2004; Peterson and Overman, 2004). Many structural features common to natural products (e.g., chiral centers, aromatic rings, complex ring system, degree of molecule saturation, and number and rotation of hetero atoms) have been shown to be highly relevant to drug discovery efforts (Kohen and Carter, 2005).

The interest in plants as source of potential chemotherapeutic agents continues, and an analysis of the number and sources of anticancer and anti-infective agents during 1983-1994 indicates that over 60% of the approved drugs developed in the disease areas are of natural origin (Cragg et al., 1997).

In India there are still hundreds of plants which have been under use as the source of medicine in traditional methods in many parts of the country. There is a need to carry out systematic studies on such plants, so that their efficacy can be checked and further they can be commercially exploited for drug preparation.

With this background, in the present study an attempt has been made to systematically evaluate the beneficial properties of one such plant viz., *Echinops echinatus* Roxb, which is being widely used in traditional medicine for large number of diseases and disorders such as asthma, dyspepsia, scrofula, syphilis, fevers, seminal debility, cancer, impotence and hysteria. Currently this plant is also being used in many Ayurvedic and Siddha formulations. This plant *Echinops echinatus* Roxb belongs to family Compositae, growing wild and abundantly available in the fields, which are uncultivated for many years.

The detailed phytochemical investigation and thorough pharmacological screening of *E. echinatus* Roxb. has been carried out in this study emphasising on the following objectives.
1) To carry out the extraction using different solvent from the roots of *E. echinatus* Roxb. by employing sequential Soxhlet extraction procedure.

2) To conduct preliminary phytochemical investigation to evaluate the chemical nature of the constituents from the different extracts of the *E. echinatus* Roxb. roots.

3) To access the antioxidant potency of the extracts of the *E. echinatus* Roxb. roots on different *in vivo* and *in vitro* models.

4) To evaluate the hepatoprotective effect of the extracts of the *E. echinatus* Roxb. roots against CCl₄-induced toxic hepatitis.

5) To evaluate the wound healing efficacy of the extracts of the *E. echinatus* Roxb. roots by using different wound models.

6) To study the anti-inflammatory activity of the extracts of the *E. echinatus* Roxb. roots against carrageenan induced paw oedema in rats.

7) To evaluate the antimutagenic property by using extracts of the *E. echinatus* Roxb. roots in animal models.

8) To study the anti-tumour effect of the extracts of the *E. echinatus* Roxb. roots in suitable animal models followed by histopathological studies in the induced tumors.

9) To isolate and characterize the chemical constituents present in the ethanol extract of roots of the plant using chromatographic techniques and spectral studies respectively.

Preliminary phytochemical screening of the ethanol extract of the root of *E. echinatus* revealed the presence of triterpenoids, alkaloids, steroids, resins, flavonoids and starch.

Bioassay-directed evaluation and chromatography of ethanol extract of *E. echinatus* root has resulted in the isolation of three bioactive constituents *viz.*, Lupeol, Betulin and Friedelin.

Methods used for the isolation of compounds were mainly column chromatography and preparative TLC using solvents with different polarities and
selectivity. The structures of all compounds were elucidated by using modern spectroscopic techniques such as IR, $^1$H NMR, $^{13}$C NMR and Mass (FAB$^+$ and EIS) spectral studies.

The present research programme signifies the importance of the roots of *E. echinatus* Roxb for its medicinal properties and also scientifically corroborated some of its ethno-medicinal claims. Among the four successive extracts of *E. echinatus* Roxb root the chloroform and ethanol extracts have shown to possess some of the important medicinal properties such as antioxidant, hepatoprotective, wound-healing and anti-tumour activities. Further, ethanol extract and its isolated compounds such as lupeol, betulin and friedelin have yielded significant information in terms of their efficacy for various pharmacological properties viz antioxidant, hepatoprotective, wound-healing, anti-inflammatory, antimutagenic and anti-tumour activities. Thus, the overall results clearly suggest that the roots of *E. echinatus* Roxb could be more useful in development of herbal drug formulation.