INTRODUCTION
During the past decade traditional systems of medicine have become a topic of global importance. In developing countries, a large proportion of the rural population rely heavily on traditional health practices to meet their primary health care needs although modern medicines are available in these countries. (Farooqi and Sreeramu, 2001) Concurrently, many people in developed countries have begun to turn to alternate or complementary therapies, including medicinal herbs. (WHO, 1999) WHO has recognized the effectiveness of herbal medicines and their biosafety.

Few medicinal plant species have been scientifically evaluated for their possible medical applications. Safety and efficacy data are available for even fewer plants. Furthermore, in developing countries the herbal medicine market is poorly regulated; and herbal products are often neither registered nor controlled. On the other hand, assurance of the safety, quality and efficacy of medicinal plants and herbal products has become a key issue in industrialized and in developing countries. (WHO, 1999).

From literature, the number of seed plants exceed 2,50,000 species. Lower plant forms have many thousand species and new species are being discovered every month. Their activities, however, are not confined to sugar and primary metabolite production only. Biosynthesis of the numerous organic compounds including complex secondary metabolites like sterols, alkaloids, pigments, phenols, oils, volatile compounds, hormones, rubber, wax etc. is an important aspect of plant life. These chemicals are plant’s defense mechanism.

Medicinal and aromatic plants are rich in secondary metabolites. They are found in forest areas throughout South Asia, from the plains to the high Himalayas to Asia Africa, America, and arid region of Thar Desert. Some of these grow very slowly in stressful environments as endemic species. Others are broadly distributed and can adapt easily to different ecological conditions. During the past decade, dramatic increase in export of medicinal plants attests to worldwide interest in these plants as well as in traditional health systems. In the last 10 years, for example, India’s exports of medicinal plants have trebled.

The Indian subcontinent is blessed with varieties of aromatic and medicinal plant species. India recognizes more than 2,500 plant species as having medicinal value, Sri Lanka about 1,400, and Nepal around 700. The agro climatic conditions and rainfall favors this biodiversity. Owing to this, Indian subcontinent is considered as a Botanical Garden of the world.
Ayurveda, our indigenous system of health care system, is accepted throughout the world. Vedas and other ancient scriptures gave clear evidence of the use of herbs and medicinal plants in ancient India. Ayurveda describes about more than 10,000 herbal formulations. The Chinese Pharmacopoeia lists over 5,700 traditional medicines, most of which are of plant origin. At present nearly one third of Americans rely on in alternative medicines along with conventional medicines. It is time to acknowledge the need of alternative medicines (Eisenberg et al., 1993). Analysis of prescriptions dispensed in the U.S.A has shown that 25% contained natural products, which remained so since 1959-1973 and was so in 1984, but the relative cost of these items has escalated from $ 3 billion to $ 8 billion (Farnsworth, 1984). It is estimated that the market potential for herbal drugs in the western world alone could range from US $ 4.9 billion to 47 billion by the year 2000 (Merillon and Ramawat, 1999).

It is estimated that around 70,000 species, from lichens to flowering trees, have been used at one time or the other for medicinal purposes (Evans, 1996). About 500 herbs are still exploited for preparation of life saving drugs. Most of these are gathered from wild plants to meet the demand. It has generated commercial demand for pharmacopoeial drugs and their products in India. Thus, despite the rich plant flora many plants are being lost. Little attention had been paid to grow them as field crops. In developing countries, efforts have now been made to introduce many drug producing plants to farmers.

NATURAL PRODUCTS:

Herbal medicinal are those products derived from plant parts that elicit a pharmacological effect. The herb is generally administered as a whole and is not fragmented or synthesized. The Food and Drug Administration prefers the term natural products (Hoffman and Leaders, 1996), which is commonly reserved for those organic compounds of natural origin that are unique to one organism, or common to a small number of closely related organisms. In most instances, they appear to be nonessential to plant, insect, or microorganisms, which produce them. Man has used natural products, albeit as crude plant extracts, since the dawn of time, and we still possess those ‘recipes’ that are efficient as
medicines for the relief of pain or alleviation of diseases, poisons for use in warfare and hunting and as narcotics, hallucinogens, or stimulants.

For example, South American Indians used curare, a plant extract that contains several toxic alkaloids, as an arrow poison. Since they discovered that, it could paralyze even large animals. A component of curare, tubocurarine, is now used as a muscle relaxant in surgery. Ephedrine, the basis of an ancient Chinese remedy for respiratory ailments, is now used in the treatment of asthma and hay fever. The psychoactive compounds like morphine (opium) and cannabinoids (cannabis) have proved irresistible to mankind through many millennia. Caffeine was, and still is, the active principle of many native beverages.

In the light of the foregoing, it is not hard to understand what motivated the early nineteenth century chemists in their efforts to isolate and characterize natural products. Between 1815 and 1860 more than twenty active principles were isolated, e.g., morphine, strychnine, quinine, caffeine, nicotine, codeine, camphor, and cocaine. However, their accurate analyses were not possible before 1835. Even then it was rarely possible to do more than present molecular formulae and describe the characteristic reactions of the compounds. Many of these reactions were novel, and new ideas of molecular structure and reactivity followed. It was therefore natural that syntheses of these compounds were then attempted. In 1952, morphine was chemically synthesized. Some compounds have defied the synthesizing efforts of some of the greatest chemists until recently.

As the structures of an increasing number of natural products became known, attempts were made to classify them in terms of structural type. In the last twenty years, with the advent of nuclear magnetic resonance spectroscopy (N.M.R), mass spectrometry, and routine X-ray crystallography, structure elucidation has become much more facile, and more time has been devoted to testing the biogenetic hypotheses. These investigations have benefited enormously from the availability of precursor molecules, such as isotopically labeled with $^{14}$C, $^3$H and most recently with $^{13}$C. It is now possible in certain instances to determine the structure of a natural product and establish its biosynthetic pathway.

It is worth noting that by structure elucidation and total synthesis, the numerous new reactions came to light. It has excited much interest. From them, revolutionary new and unifying concepts arose.
NECESSITY AND FUTURE IN INDIGENOUS DRUGS:

The term indigenous drugs has been used, in its widest sense, to include within its scope not merely those drugs, which are originally natives to India, but also those, which were introduced from outside and have become naturalized in India. The Indian indigenous drugs have become a great importance from professional and economic point of view.

From folk medicine and traditional system of medicine that include Ayurveda, Unani and Siddha in India, medicinal plants were adopted into modern system of medicine after they have been found as effective remedies through chemical and pharmacological screening. Later the pharmacological actions of the active principles were worked out. Ultimately the active principles were suitably formulated as modern medicines.

PRODUCTS STANDARDIZATION

For popularizing Ayurvedic and other traditional medicines it is necessary to promote a) standardization, b) safety, c) quality, d) authenticity of practices and the products. At least one drug for each major disease should be identified. Its manufacturing process, quality control, toxicology and clinical trial are necessary. Good Manufacturing Practices (GMP) should be adopted by manufacturers for manufacturing herbal-based medicines. There should be a State Drug Testing Laboratory to check the quality and standard of these medicines. All pharmacies should have a research and development activity at least to provide rationale to the products they want to sell in the market.

Ayurvedic industry should incorporate the latest advances of science and technology in the manufacturing process and clinical practices and guidelines should be framed for patent and proprietary medicines and manufacturer to have efficacy and safety.

DISTRIBUTION OF MEDICINAL PLANTS

Macro analysis of the distribution of medicinal plants show that they are distributed across diverse habitats and landscape elements. Around 70% of India's medicinal plants are found in tropical areas mostly in the various forest types spread across the Western, Eastern
Ghats. Less than 30% of the medicinal plants are found in the temperate and alpine areas, in the dry regions and moist deciduous areas. Analysis of habits of medicinal plants indicates that one third are trees and equal portion shrubs and the remaining one-third are herbs. A very small portion of them is lower plant like lichens, fern, algae, etc. The distribution is as follows:

- Trees = 33%
- Shrubs = 20%
- Herbs = 32%
- Climber = 12%
- Others = 3%

In India the 386 families and 2200 genera in which medicinal plants are recorded, the families like Asteraceae (419) species, Euphorbiaceae (214) species, Laminaceae (214) species, Fabaceae (214) species, Rubiaceae (208) species, Poaceae (168) species, Acanthaceae (141) species, Rosaceae (129) species and Apiaceae (118) species share the larger portion of medicinal plant species.

CONSERVATION OF MEDICINAL PLANTS:

A large majority of medicinal and aromatic plant materials are collected from the wild. As natural habitats for wild plants become endangered. They are disappearing, making it difficult to acquire certain plant derived chemicals from nature. An important alternative source of a drug is the near relative of already known plant species, because the biosynthetic pathway would be same in the two. There has been considerable interest in investigating the potentials of plant cell culture as an alternative to industrial production of such products, e.g. immobilized cell culture technique might be revolutionary.

Both conservation strategies i.e. in situ and ex situ can be adopted for conservation of medicinal plants. In situ conservation means conservation of plants in their natural habitats-in biosphere reserves, sanctuaries and national parks, if necessary through micro propagation.

Ex situ conservation can be accomplished by cultivating and/or maintaining plants in botanic gardens, parks, other suitable sites, and through long term preservation of plant propagules in gene bank and plant tissue culture repositories (cryopreservation).
SOURCES OF NEW DRUGS:

Traditional systems of medicine remain the major source of health care for more than two thirds of world's population. Impressive progress has been made in certain developing countries like China and India through integration of Traditional with Western Systems and the application of modern science and technology to the promotion and development of traditional medicine. There are various areas where plant drugs are used. Various natural products of plant origin have antiprotozoal activity like quinine infusion from *Cinchona* in malaria, artemisine from *Artemesia* for fever and malaria. Unstable allicin is formed in garlic, which is antifungal; ricin from castor is specific immunotoxin against protozoa and cancer cells.

Recently, the development of phytochemistry has raised the hope for remedies in chronic and/or deadly diseases. It has generated a new enthusiasm in researchers to develop herbal medicine. Many important medicinal plants of ancient "materia medica" have been carefully investigated from different viewpoints. Notable works are available from national and international research centers and universities in India and abroad, and has brought into prominence the merits and qualities of various plant drugs. Their structures are now known and available at databank.

When plant extracts are fractionated by solvents, a drug may be obtained. In drug-form, metabolite is highly concentrated. Naturally, to a mammalian cell like ours it would show side effects because it is toxic. However, in very minute quantity (picomole or below) it may trigger a disease resistance mechanism. A few natural products (drugs) of plant origin are: quinine from *Cinchona* bark, berberine from *Berberis*, artemisine from *Artemesia*, harmaline from *Peganum*, triterpenes from many plant species including *Simarubacius* etc. These compounds have antiprotozoal property. Similarly, antibacterial, antifungal, and antiviral drugs (compounds), were discovered from plant species, such as nimbidine from *Azadirchta indica*, allicin from common garlic (*Allium sativa*). Infusions of flowers from *Sambucus nigra*, aerial parts of *Hypericum perforatum* and roots of *Saponaria officinalis* have antiviral properties. Similarly, anticancer drugs were developed from plant source e.g. ricin from castor seed, podophyllin from *Podophyllum* fruit/tuber, taxol from *Taxus baccata*, etc.
vincristine and vimblastin from *Vinca rosea* roots, colchicine from *Colchicum autumnale* etc. Colenol from *Coelus forskholhi* is marketed by Hoechst under the name of forskolin as hypertensive drug. Taxol from *Taxus* species is currently developed, as anticancer drug marketed by Dabur. Bacoposides from *Bacopa moniera* is launched by Velvette under the name of 'Memory-plus' as memory enhancer. Insipite of such advances, there are various areas like tropical diseases, viral diseases, herpes, AIDS, cancer, mental deficiency, parkinsonian etc. that may be tapped from plants in future. Liquorice is used against inflammed stomach. Oleanolic acid, sericic acid, nimbidium, catechin, lapschol, and quillia saponins are plant derived antiulcer drug.

A variety of drugs are available as antiasthmatic viz., lobeline from *Lobelia*, ephedrine from *Ephedra* and Vasicine from Vasaka. Disodium chromoglycolate etc. as antidiabetics like insulin are noticed in 148 plants of 50 families including *Catharanthus roseus*, *Gymnema sylvestris*, and *Pterocarpus marsupium*. Corydaline in Corydalis tubers have good pain killing and anti ulcer properties. Hypertensive compound was isolated from *Rawolfia serpentina*. Digitalin (found in *Digitalis purpurea*) is a cardiotonic and yellow oleander fruit has steroidal cardiotonic property. There are plenty of plant cardiovascular drugs to list. Roots of “janti”and “rasna”are used in neuralgia. “Guggulipid”, an olegum resin from *Commiphora* species, is marketed by Cipla as antihyperlipidemic, anti-inflammatory and in obesity. “Copper Pod” is used in gargles tooth powder and eye lotion as an effective anti-inflammatory agent. *Withania somnifera*, *Glycyrrhiza*, nutmeg, plant parts are used against arthritis. Rhizomes of turmeric are used for sprains and bruises.

Inspite of so much potential and scope of future development of plant based drugs, less 2 % of the total flora was used. The major pitfalls in plant drug research include lack of standardization, confusion in nomenclature, controversial botanical identification, danger of extinction of some plants due to over exploitation from the habitats, lack of proper dosage formulations, and frustrating experiences of searching for active principles from plant and animal sources. Due to lack of standardization it is not possible to ensure reprocessing of these drugs from batch to batch. However modern instrumentation and biological assay methods may provide the possibility of developing suitable quality control criteria even on polyherbal formulations.

Following is a list of plant-derived drugs:
### TABLE-I: PLANT DERIVED DRUGS OF KNOWN STRUCTURE USED ON A GLOBAL BASIS

<table>
<thead>
<tr>
<th>Name of the Family &amp; Plant</th>
<th>Potent Drug</th>
<th>Therapeutic Category/ Use</th>
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</thead>
<tbody>
<tr>
<td><strong>Acanthaceae</strong></td>
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<tr>
<td><em>Andrographis paniculata</em></td>
<td>Andrographolide</td>
<td>Hepatoprotectant</td>
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<tr>
<td><em>Adhatoda vasica</em></td>
<td>Vasicine, Vasicinone</td>
<td>Oxytocic, bronchodilator</td>
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<tr>
<td><strong>Amaryllidaceae</strong></td>
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<tr>
<td><em>Agave americana</em></td>
<td>Hecogenin</td>
<td>Precursor in steroidal hormones, Rheumatoid arthritis</td>
</tr>
<tr>
<td><strong>Anacardiaceae</strong></td>
<td></td>
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</tr>
<tr>
<td><em>Anacardium occidentalis</em></td>
<td>Catechin, Epicatechin</td>
<td>Anti-inflammatory, Hepatoprotectant</td>
</tr>
<tr>
<td><strong>Apocynaceae</strong></td>
<td></td>
<td></td>
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<tr>
<td><em>Strophanthus hispidus</em></td>
<td>K-strophanthidin</td>
<td>Cardiotonic</td>
</tr>
<tr>
<td><em>Rauwolfia serpentina</em></td>
<td>Reserpine, Ajmaline</td>
<td>Sedative, Anti-hypertensive</td>
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<tr>
<td><em>Holarrhena antidysenterica</em></td>
<td>Conessine</td>
<td>Amoebicidal</td>
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<tr>
<td><em>Thevetia nerrifolia</em></td>
<td>Thevetin</td>
<td>Cardiotonic</td>
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<tr>
<td><strong>Asclepiadaceae</strong></td>
<td></td>
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<tr>
<td><em>Tylophora asthmatica</em></td>
<td>Tylophorine, Tylocrebine</td>
<td>Anticancer</td>
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<tr>
<td><strong>Berberidaceae</strong></td>
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</tr>
<tr>
<td><em>Podophyllum hexandrum</em></td>
<td>Podophyllin</td>
<td>Anticancer</td>
</tr>
<tr>
<td><em>Berberis aristata</em></td>
<td>Berberine</td>
<td>Astringent, curative of piles</td>
</tr>
<tr>
<td><strong>Bromeliaceae</strong></td>
<td></td>
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<tr>
<td><em>Ananas comosus</em></td>
<td>Bromelin</td>
<td>Enzyme which aids digestion</td>
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<tr>
<td><strong>Burseraceae</strong></td>
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<tr>
<td><em>Boswellia serrata</em></td>
<td>Oleogum resin</td>
<td>Anti-inflammatory</td>
</tr>
<tr>
<td><em>Commiphora mukul</em></td>
<td>Oleogum resin</td>
<td>Astringent, antiseptic, anti-hyperlipidemic</td>
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<tr>
<td><strong>Campanulaceae</strong></td>
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<tr>
<td><em>Lobelia inflata</em></td>
<td>Lobeline</td>
<td>Use in Bronchial Asthma</td>
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<tr>
<td><strong>Caricaceae</strong></td>
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<tr>
<td><em>Carica papaya</em></td>
<td>Papain</td>
<td>Enzymatic debridement</td>
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<tr>
<td><strong>Celastraceae</strong></td>
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<tr>
<td><em>Celastrus paniculatus</em></td>
<td>Pristimerin</td>
<td>Antiprotozoal</td>
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<tr>
<td><strong>Chenopodiaceae</strong></td>
<td></td>
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<tr>
<td><em>Chenopodium ambrosioides</em></td>
<td>Ascaridole</td>
<td>Antihelmintics</td>
</tr>
<tr>
<td>Name of the Family &amp; Plant</td>
<td>Potent Drug</td>
<td>Therapeutic Category/ Use</td>
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<tr>
<td><strong>Compositae</strong></td>
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<tr>
<td>Artemisia annua</td>
<td>Artimisin</td>
<td>Antiprotozoal</td>
</tr>
<tr>
<td>Silybum marianum</td>
<td>Silymarin</td>
<td>Hepatoprotectant</td>
</tr>
<tr>
<td>Taraxacum officinale</td>
<td>Taraxin, Taracerin, Taraxsterol</td>
<td>Diuretic, treatment of chronic disorder of kidney and liver.</td>
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<tr>
<td><strong>Cucurbitaceae</strong></td>
<td></td>
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<tr>
<td>Momordica charantia</td>
<td>Momordicine</td>
<td>Antidiabetic</td>
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<tr>
<td><strong>Dioscoreaceae</strong></td>
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<tr>
<td>Dioscorea deltoidea</td>
<td>Diosgenin</td>
<td>Drugs for rheumatoid arthritis, precursor for preparing steroidal hormones</td>
</tr>
<tr>
<td><strong>Erythroxylaceae</strong></td>
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<tr>
<td>Erythroxylum coca</td>
<td>Cocaine</td>
<td>Local anaesthetic</td>
</tr>
<tr>
<td><strong>Euphorbiaceae</strong></td>
<td></td>
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<tr>
<td>Phyllanthus embelica</td>
<td>Phyllanthin</td>
<td>Anti-hepatotoxic</td>
</tr>
<tr>
<td><strong>Gnetaceae</strong></td>
<td></td>
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<tr>
<td>Ephedra gerardiana</td>
<td>Ephedrine, Pseudoephedrine</td>
<td>Bronchodilator</td>
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<tr>
<td><strong>Guttiferae</strong></td>
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<tr>
<td>Garcinia kola</td>
<td>Kolaviron</td>
<td>Hepatoprotectant</td>
</tr>
<tr>
<td>Mesua ferrea</td>
<td>Mesuol, mesuone</td>
<td>Anti-bacterial</td>
</tr>
<tr>
<td><strong>Hypocreales</strong></td>
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<tr>
<td>Ergot (Claviceps purpurea)</td>
<td>Ergometrine, Ergotamine</td>
<td>Oxytocic, Treatment of migraine</td>
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<tr>
<td><strong>Labiatae</strong></td>
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<tr>
<td>Coleus forskohlii</td>
<td>Colenol</td>
<td>Cardiotonic</td>
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<tr>
<td><strong>Leguminosae</strong></td>
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<tr>
<td>Cassia acutifolia</td>
<td>Sennoside-A</td>
<td>Laxative</td>
</tr>
<tr>
<td>Cassia angustifolia</td>
<td>Sennoside -B</td>
<td>Laxative</td>
</tr>
<tr>
<td>Sophora japonica</td>
<td>Rutin</td>
<td>Treatment of injury due to atomic radiation</td>
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<tr>
<td>Glycyrrhiza glabra</td>
<td>Glycyrrhizin</td>
<td>Anti-ulcer, expectorant</td>
</tr>
<tr>
<td>Vicia faha</td>
<td>L-dopa</td>
<td>Parkinson's disease</td>
</tr>
<tr>
<td>Physostigma venenosum</td>
<td>Physostigmine</td>
<td>Mainly in ophthalmology, anti-spasmodic</td>
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<tr>
<td>Pterocarpus marsupium</td>
<td>Epicatechin</td>
<td>Antidiabetic</td>
</tr>
<tr>
<td>Trigonella foenumgraecum</td>
<td>Tuberosin</td>
<td>Antidiabetic</td>
</tr>
<tr>
<td>Pueraria tuberosa</td>
<td></td>
<td>Antifertility</td>
</tr>
<tr>
<td>Cyamopsis tetragonoloba</td>
<td>Guar -gum</td>
<td>Antidiabetic, stabilizer &amp; thickener in food</td>
</tr>
<tr>
<td>Name of the Family &amp; Plant</td>
<td>Potent Drug</td>
<td>Therapeutic Category/ Use</td>
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<tr>
<td>Liliaceae</td>
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<tr>
<td><em>Colchicum autumnale</em></td>
<td>Colchicine</td>
<td>Antigout and inducing polyploidy</td>
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<tr>
<td><em>Allium sativum</em></td>
<td>Allicin</td>
<td>Antiprotozoal</td>
</tr>
<tr>
<td><em>Asparagus racemosus</em></td>
<td>Shatavarin I-IV</td>
<td>Galactagogue</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Gossypol</td>
<td>Male contraceptive</td>
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<td><em>Gossypium arboreum</em></td>
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<tr>
<td>Meliaceae</td>
<td>Nimbidin</td>
<td>Antiseptic</td>
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<td><em>Azadirachta indica</em></td>
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<td>Myristicaceae</td>
<td>Myristin</td>
<td>Choleretic</td>
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<td><em>Myristica fragrans</em></td>
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<td>Nyctaginaceae</td>
<td>Punarnavine</td>
<td>Liver protectant, Diuretic</td>
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<tr>
<td><em>Boerhaavia diffusa</em></td>
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<tr>
<td>Papaveraceae</td>
<td>Morphine, Codeine</td>
<td>Narcotic analgesic, Antitussive and Analgesic</td>
</tr>
<tr>
<td><em>Papaya somniferum</em></td>
<td>Rutin</td>
<td>Treatment of capillary fragility</td>
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<tr>
<td><em>Fagopyrum tataricum</em></td>
<td>Rutin</td>
<td>To correct the injury due to atomic radiation</td>
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<tr>
<td>Polygonaceae</td>
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<tr>
<td><em>Fagopyrum esculentum</em></td>
<td>Rutin</td>
<td></td>
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<tr>
<td><em>Fagopyrum tataricum</em></td>
<td>Rutin</td>
<td></td>
</tr>
<tr>
<td>Rubiaceae</td>
<td>Quinidine, Quinine</td>
<td>Antimalarial, Anti-arrythmic</td>
</tr>
<tr>
<td><em>Cinchona officinalis</em></td>
<td></td>
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<tr>
<td><em>Cinchona ledgeriana</em></td>
<td>Quinidine, Quinine</td>
<td>Antimalarial, Anti-arrythmic</td>
</tr>
<tr>
<td><em>Cinchona calisaya</em></td>
<td>Quinidine, Quinine</td>
<td>Antimalarial, Anti-arrythmic</td>
</tr>
<tr>
<td><em>Cinchona succirubra</em></td>
<td>Quinidine, Quinine</td>
<td>Antimalarial, Anti-arrythmic</td>
</tr>
<tr>
<td><em>Cephaelis ipecacuanha</em></td>
<td>Emetine</td>
<td>Antiamoebic, Expectorant</td>
</tr>
<tr>
<td>Rutaceae</td>
<td>Pilocarpine</td>
<td>Treatment of glaucoma</td>
</tr>
<tr>
<td><em>Pilocarpus jaborandi</em></td>
<td></td>
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</tr>
<tr>
<td>Sapindaceae</td>
<td>Aescin</td>
<td>Anti-inflammatory</td>
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<tr>
<td><em>Aesculus hippocastanum</em></td>
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<tr>
<td>Scrophulariaceae</td>
<td>Digitoxin, Gitoxin</td>
<td>Treatment of congestive heart failure.</td>
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<tr>
<td><em>Digitalis purpurea</em></td>
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<td><em>Digitalis lanata</em></td>
<td>Digitoxin, Gitoxin, Digoxin</td>
<td>Auricular fibrillation Hepatoprotectant</td>
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<td>Kutkoside</td>
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<td><em>Bacopa moniera</em></td>
<td>Bacopside</td>
<td>Memory-enhancer</td>
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<tr>
<td>Solanaceae</td>
<td>Atropine</td>
<td>Anti-cholinergic</td>
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<td><em>Atropa belladona</em></td>
<td>Hyoscyamine</td>
<td>Sedative and Anti-cholinergic</td>
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<td><em>Hyoscyamus niger</em></td>
<td>Solasodine</td>
<td>Precursor for steroidal hormones</td>
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<td><em>Solanum khasianum</em></td>
<td>Withanolides</td>
<td>Immunostimulant</td>
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<td><em>Withania somnifera</em></td>
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<td>Name of the Family &amp; Plant</td>
<td>Potent Drug</td>
<td>Therapeutic Category/ Use</td>
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<td>Taxol</td>
<td>Anticancer</td>
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<td>Valepotriates</td>
<td>Sedative, tranquilizer</td>
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<td><em>Nardostachys jatamansi</em></td>
<td>Valeranone</td>
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<tr>
<td><em>Curcuma longa</em></td>
<td>Curcumin</td>
<td>Anti-parasitic, blood purifier</td>
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<tr>
<td><em>Costus speciosus</em></td>
<td>Diosgenin</td>
<td>Precursor for steroidal hormones</td>
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<td><strong>Zygophyllaceae</strong></td>
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<tr>
<td><em>Tribulus terrestris</em></td>
<td>Saponins</td>
<td>Diuretics, Kidney stones.</td>
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EXTRACTION AND EVALUATION OF DRUGS:

Crude drugs consist of natural substances that have undergone no change in constituents during collection drying and processing. Often crude drugs are used as therapeutic agents but, more frequently, their chief principles are separated by various means. The principles are known as extractives.

The mode of harvesting depends upon the pharmaceutical requirement of drugs. Drying plant materials removes sufficient moisture to ensure good-keeping quality and prevents molding, enzymes, and the action of bacteria, chemicals or other possible changes. Proper and successful drying involves two main principles – (a.) temperature control (b.) regulation of airflow.

The plant material can be dried either by natural sun drying or by the use of artificial heat. Sun drying may be affected by the direct action of sunlight. Drying with artificial heat is generally the most acceptable method because it has the distinct advantage over air-drying in that it immediately stops enzymatic action. Leaves and over ground plants are spread in thin layers on trays and are dried at moderate temperature of about 40°C-60°C provided the active principles are not destroyed by this elevated temperature.

The identification of the crude drug is performed by comparing a representative sample of the unknown with a published description or with an authentic sample. After identification, the isolation of constituents is possible with suitable solvents either by percolation or by soxhlation. The undissolved portion of the drug that remains after the extraction is called the marc. This is followed by identification of the constituents and their contents in the solvent.

After identification of the active constituents, they are isolated by chromatographic techniques. In recent years, the study of chromatography has become prominent means of separating and analyzing organic and inorganic materials. The materials separated in this way can be identified by analytical methods. These identified compounds are then subjected for measurement of various pharmacological parameters. The pharmacology embraces the knowledge of the history, source, physical and chemical properties, compounding, biochemical and physiological effects, mechanism of action, adsorption, distribution, biotransformation, excretion, therapeutic and other uses of drugs.
PRIMARY AND SECONDARY METABOLISM:

All organisms possess similar metabolic pathways by which they synthesize and utilize certain essential chemical species. This is primary metabolism. The primary compounds (metabolites), are essential for the survival and well being of the organism. Secondary metabolism is the metabolism of endogenous compounds by specialized proteins and enzymes. They are an expression of cell specialization, which is either triggered by the process of cell differentiation, or it represents an aspect of plant development. The biosynthesis of secondary compounds is usually limited to a particular developmental stage and/or in specialized cells (Endress, 1994). Most organisms also utilize other metabolic pathways, producing compounds that usually have no apparent utility: these are the ‘natural products’ and are known as secondary metabolites. The dividing line between primary and secondary metabolism is rather blurred. In addition, the two types of metabolism are interconnected. Since primary metabolism provides a number of small molecules. They are employed as starting materials for important secondary metabolic pathways. Secondary metabolites are now known to be very necessary to plant life by providing a defense mechanism against bacterial, viral, and fungal attack, analogous to the immune system of animals. There are three principal starting materials (or ‘building blocks’) for secondary metabolism:

a) Shikimic acid, the precursor of many aromatic compounds including the aromatic amino acids, cinnamic acids, and certain polyphenols;

b) Amino acids, leading to alkaloids, and peptide antibiotics including the penicillin and cephalosporins;

c) Acetate, precursor of polyacetylenes, prostaglandin, macrocyclic antibiotics, polyphenols, and the isoprenoids (terpenes, steroids and carotenoids), via two entirely separate biosynthetic pathways.
INTERACTIONS AND INTERRELATIONSHIPS BETWEEN PRIMARY AND SECONDARY METABOLISM.

The metabolism of the living cell is dynamic. There is no obvious boundary between primary and secondary metabolism, the flow of metabolite adjusting subtly to changes in cellular activity and metabolic demand. Little is known of the control mechanisms which integrate and maintain a balance between primary and secondary metabolism, or what regulates the flow of metabolite into, perhaps competing, secondary metabolic pathways. With the help of artificial or natural mutants, the genes responsible for secondary metabolite production are being fished out and characterized.

The nature of events occurring in primary metabolism is a key influence in determining the pattern and level of secondary metabolite synthesis. The pattern of secondary metabolism, in a cell culture, depends on many interacting factors, including the physiological status of the culture, its nutrition, its origin, age, degree of development, and so on. The nutrients of course not only feed the primary metabolic pathways, but in modified form also serve as entry points into secondary metabolism. In the case of nutrients, there is a need to determine the optimal dietary intake of these chemicals to provide maximal protection against diseases. Numerous entry points exist linking the primary metabolic pathways to secondary metabolic pathways.

POTENTIALITIES AND APPLICATION OF TISSUE CULTURE FOR FUTURE EXPLOITATION OF PLANTS:

As the natural habitats for wild plants, particularly the economically important plants become endangered or are disappearing due to commercial exploitation, it is very difficult to collect these important plants from wild habitats and also to maintain the productivity of drugs. Thus, alternative method of conservation and large-scale propagation of these economically important plants are very important. One of the most important techniques is plant tissue culture (Fowler, 1983; Staba, 1982) for rapid multiplication of these plants in a controlled condition. This technique is also essential for:

• Raising virus disease free plant.
• Germplasm conservation for future use.
• A means to transfer of genes of interest into a crop plant.
• Facilitate extraction of secondary metabolites from cultured cells, organs of plants.

With the refinement of tissue culture methodology the production of secondary metabolites has been improved in certain cases under higher amount of products were found in cultured tissues/cells than the intact plants from which they were derived. Therefore, much attention has been received to boost up secondary metabolite production though plant tissue culture particularly if that can be performed in industrial scale ‘fermenter’. Factory-type production of natural compounds can be carried out throughout the year in culture vessels, unaffected by the season. The risk of crop failure due to natural hazards and the danger of extinction of some species due to their mass extraction from natural populations are thus eliminated. Also, cell cultures not only provide means for de novo synthesis of natural products, it also serves as factories for bioconversion of low value compounds to high value products. So, some novel compounds that are produced in cultured cell are not produced in intact plants.

However, there are instances of a few disadvantages of plant tissue culture for the production of secondary metabolites. Plant growth regulators affect growth and differentiation. Thus, they may affect secondary metabolite production in cultured cells. In general, an increase in auxin level, such as, 2,4-dichlorophenoxyacetic acid (2,4-D), that stimulates differentiation and proliferation of cells, reduces the level of secondary metabolite production.
Interactions between primary and secondary metabolism

(After: Fowler, 1986. p. 105)
The present work deals with the chemical characterization and pharmacological evaluation of four medicinal plants namely-

*Aloe vera* L. syn. *A.barbadensis* L. Family Liliaceae.


*Acorus calamus* L. Family Araceae.

*Withania somnifera* L. Family Solanaceae.

*Aloe vera* L. syn. *A.barbadensis* Mill.

**Family Liliaceae**

**Synonyms:** Aloc; Ghrit kumari (Sanskrit)

Over the years, aloe plant has been known by a number of names such as ‘the wand of heaven’, ‘heaven’s blessing’ and ‘the silent healer’.

The *Aloe vera* Linn. plant is also identified as *Aloe barbadensis* Miller. It is otherwise called as Curacao aloe. It is the most medicinally potent of the 300 (and more) varieties found around the world. *Aloe vera*, a native to America, is now naturalized in India in dry warm regions particularly in western parts. It is cultivated for its foliage and beautiful inflorescence. *A.barbadensis*, a native of Northern Africa, is cultivated in many other tropical countries.

**Botany, Habitat:**

Aloe plant is either stemless, bearing a rosette of large, thick, succulent leaves, or have a stem (up to 1.5 m in length) along with or at the end of which the leaves are borne. Fleshy leaves are usually lance-shaped up to 50 cm in length, with a sharp apex and a spiny margin; differently colored from gray to bright green, sometimes striped or mottled, the upper leaf surface is flat or lightly concave, the lower surface strongly convex. Erect unbranched flower rises after rainy season in winter. The inflorescence (a raceme) is borne on a simple or branched scape, originating from the rosette: flowers are small, tubular, red, yellow, or white. The fruit is a capsule.

The majority of the species are diploid (Brandham, 1971) with the chromosome number 2n=14, with a bimodal karyotype complement including eight long and six short
acrocentric chromosomes (Sapre, 1978). This character indicates a hybrid situation where two plant genomes, one having long chromosomes and another having short chromosomes, assemble together in remote past. Then the two genomes became tolerant to each other—thus the plant a diploid that may bear fertile fruits. However sterility which is a common phenomenon for an alloplloid plant, is common in aloe plant.

Examination of aloe leaf sections reveals the presence of three types of cells at the phloem pole of the vascular bundles: aloin producing cells, outer bundle sheath cells, and fibres (Cutler et al., 1980). The majority of the species have aloin cells of various sizes which produce a copious exudates containing the active principles of the aloe drug (Cutler, 1972). It was suggested that the aloin cells act as storage tissue (Beaumont et al., 1986).

_Aloe vera_ flourishes on poorest soil and it can be easily propagated by means of suckers. Vegetative propagation is in many cases a forced propagation practice for this plant species owing to the occurrence of wide range of male sterility in this plant (Keijzer and Cresti, 1987). There are irregularities in pollen meiosis in _Aloe barbadensis_, which often shows a high percentage of pollen sterility (58.3%). Moreover when pollen grains seemed normal, failure in fruit set was also observed (Sapre, 1975). It seems the genome complements are still incompatible in a mother cytoplasm. As a general rule, even when seed production is possible, vegetative propagation gives a rapid means of multiplication and is preferred. This method of reproduction also shows a strong reduction in genetic variability for cultivated _Aloe_ varieties. _Aloe vera_ plants are cultivated in spaced rows, planted out immediately at the end of the rainy season, and outer leaves are harvested from the second year. Aloe juice is collected from August to October, by cutting leaves from which the juice flows out. Aloes have been used therapeutically, certainly since Roman times and perhaps long before (Morton, 1961; Crosswhite and Crosswhite, 1984), different properties being ascribed to the inner, colorless, leaf gel and to the exudates from the outer layers.

The popular interest and use of the gel have increased dramatically in recent years. In this country, it is now a familiar ingredient in a range of healthcare and cosmetic products. The preserved but otherwise non-treated gel is also sold as a therapeutic agent. This commercial activity has been accompanied by an upsurge of both clinical and chemical research, which is reaching more closely towards the active ingredients and their biological activity. There are now fewer doubts as to the efficacy of the material, although there are
some warnings of allergic side effects (Klein and Penneys, 1988; Briggs, 1995). Harmful reactions to aloe gel treatment are recorded infrequently (Hunter and Frumkin, 1991; Schmidt and Greenspoon, 1993).

There is still confusion between the leaf exudates and the gel (Morsy and Ovanoviski, 1983; Duke, 1985; Natow, 1986; Ahmad et al. 1993). However, many commentators clearly distinguish the two parts (Watson, 1983; McKeown, 1987; Capasso et al., 1998) and describe in some detail how the gel is prepared (Mc Analley, 1988; Agarwal, 1997) At one time there was much discussion about the relative efficiency of decolorized and colourised, i.e. with exudates components gels (Danof, 1987; Agarwal, 1997). There is also a feeling that some of the variable results reported in the literature may be due to treatment of the gel subsequent to harvest (Fox, 1990; Marshall, 1990; Briggs, 1995; Agarwala, 1997). It is very important to have a small quantity of sap in the gel as it contains the anthraquinone fraction, which has been shown to posses antimicrobial and analgesic action. This sort of gel is yellow or orange in color and contains cellular material from the plant and has a bitter taste.

The emphasis is now changing towards definition of the active constituents so that they can be used accurately in formulations (Reynolds, 1998). The action of aloe gel as a moisturizing agent is stills a popular concept (Meadows, 1980; Watson, 1983; Natow, 1986; Danof, 1987; Mc Keown, 1987; Fox, 1990; Marshall, 1990; Briggs, 1995). Freshly harvested Aloe vera gel oxidizes very quickly and so must be stabilized. Gel is stabilized using a cold process ensuring that none of the essential ingredients within the gel are lost or damaged.

**Chemical constituents:**

The aloe gel contains mainly water (about 99%) and has a pH of 4.5. It’s remaining part (1%), the solid matter, contains the active constituents. There are over 75 different health giving ingredients in Aloe vera, which include vitamins, minerals, enzymes, sugars, anthraquinones (phenolic compounds), lignin, saponins, sterols, amino acids and salicylic acid. Vitamins that are found in Aloe vera include the important antioxidants like vitamins A, C and E as well as vitamins B (thiamin), niacin, vitamin B2 (riboflavin), choline and folic acid as well as B12 (a rarity in plants).
Enzymes

Aloe vera leaf extracts contain amylase and lipase, which may aid digestion by breaking down fats and sugars. One of its important enzymes, a carboxy-peptidase, inactivates bradykinins and produces an anti-inflammatory effect. During the inflammatory process, bradykinin produces pain associated with vasodilation and, therefore, its hydrolysis reduces these two components and produces an analgesic effect (Obata et al., 1993; Shelton, 1991).

Minerals

Sodium, potassium, calcium, magnesium, manganese, copper, zinc, chromium and iron are all found in the aloe gel. Magnesium lactate inhibits histidine decarboxylase and prevents the formation of histamine from the amino acid histidine (Shelton, 1991). Histamine is released in many allergic reactions and causes intense itching and pain. The prevention of its formation may explain the antipyretic effect of Aloe vera.

Another simple substance, magnesium lactate is present in aloe gel. It is said to inhibit the production of histamine decarboxylase (Rubel, 1983; Natow, 1986; Marshall, 1990; Shelton, 1991; Canigueral and Vila, 1993). Inhibition of pain producing substances such as bradykinin or Thromboxane is often claimed as aloe gel constituent (Rubel, 1983; Natow, 1986; Danhoff, 1987; Fox, 1990; Marshall, 1990; Shelton, 1991; Canigueral and Vila, 1993). On a more sophisticated level, action of aloe gel on the immune system has been postulated and to some extent tested (Rubel, 1983; Schechter, 1994; Griggs, 1996).

Sugars

Sugars are derived from the mucilage layer of the aloe leaf under the rind, surrounding the inner parenchyma or gel. They form 25 per cent of the solid fraction and comprise both mono- and polysaccharides. By far the most important of them are the long chain polysaccharides, comprising of glucose and mannose, known as the gluco-mannans [Beta - (1, 4) - linked acetylated mannan]. When taken orally, some of these bind to receptor sites that line the gut and form a barrier, possibly helping to prevent 'leaky gut syndrome'. While others are ingested whole by a method of cellular absorption (pinocytosis). Unlike other sugars, which are broken down prior to absorption, the polysaccharides are absorbed
complete and appear in the blood stream unchanged. Here, they act as immuno-modulators that are capable of enhancing and retarding the immune response (Green, 1996; Kahlon et al., 1991; Sheets et al., 1991).

Polysaccharides are another group of gel constituents to which activity immunomodulatory reactions and one acemannan have reached proprietary status (Schechter, 1994; McAnalley, 1988; Agarwala, 1997). Recently scientists are giving much more stress on the biological activity of polysaccharides (Franz, 1989; Tizard et al., 1989; Mc Auliffe and Hinsdale, 1997). Antibacterial, antifungal and antiviral properties of Aloe gel were demonstrated by the researchers (Klein and Penneys, 1988; Marshall, 1990; Ahmad et al., 1993). Although Aloe vera gel is the only one being used commercially, there is the possibility of discovering other useful properties among the other 300 or more Aloe species for cosmetics and burns (Newton, 1987).

**Anthraquinones**

These phenolic compounds are found in the sap. The bitter aloes consist of free anthraquinones and their derivatives such as

- Barbaloin-10- (1151 — anhydroglucosyl) — aloe-emodin-9-anthrone)
- Isobarbaloin
- Anthrone-C-glycosides and chromones.

Large amounts these compounds exert a powerful purgative effect, but in small amounts when absorbed from the gut, they are potent antimicrobial agents (Lorenzetti et al., 1964; Sims et al., 1971 a), and also possess powerful analgesic effects. Topically, these compounds can absorb ultra violet light, inhibit tyronase activity, and reduce the formation of melanin and any tendency to hyper-pigmentation (McKeown, 1987; Strickland et al. 1993). Lignin a woody substance, that is present in aloe gel, endows a typical aloe preparations with their singular penetrative ability to carry other active ingredients deep into the skin to nourish the dermis

**Saponins**

These soapy substances form 3 per cent of the gel and are general cleansers, having antiseptic properties (Hirat and Suga, 1983).
Plant Sterols

These include campestral, sitosterol and lupeol. B-sitosterol as well as other fatty acids found in *Aloe vera* gives effective relief for allergic reactions and acid indigestion as well as helping lowering cholesterol levels.

Salicylic acid


Amino acids

*Aloe vera* gel provides 20 necessary amino acids required by the human body and seven of the eight essential amino acids. Due to these amino acids it has a skin rejuvenating effect on epithelial tissues. (Davis *et al.*, 1987; Fulton, 1990; Marshall *et al.*, 1993; Winters, 1993; Heggers *et al.*, 1996; Green 1996).

Burns and incisions-

Aloe gel has been used as a therapeutic purpose for sunburn and frostbite. Experimentally it has been tested against UV burn produced by a bank of UV lights (Danhoff and McAnally, 1983; Crowell *et al.*, 1989; Heggers *et al.*, 1993; Strickland *et al.*, 1994; Miller and Koltai, 1995).

Effects on oedema produced by irritating compounds -

It has been reported that inflammation by croton oil on rabbit’s ear, as an experimental model, was measured by weighing a tissue punch sample and was shown to decrease after topical application of aloe gel (Davis *et al.*, 1987b, 1989a,b).

Effects on gastrointestinal functions and ulcers:

Aloe gel is offered commercially for oral consumption. A series of trials on human patients indicate a tonic effect on the intestinal tract with a reduced transit time. Bowel
putrefaction was reduced and protein digestion/absorption improved (Bland, 1985). An early trial with human patients found oral administration of aloe gel is effective against the treatment of peptic ulcer (Blitz et al., 1963) although its mode of action could not be ascertained. However these observations were contradicted by later experiments by inducing gastric and duodenal ulcers in rats where both the aloe exudates and the gel were found to be ineffective. (Parmar et al., 1986).

**Anti-diabetic activity:**

Diabetes mellitus is a disorder of carbohydrate metabolism characterized by lowered insulin secretion. It is a syndrome with both hereditary and environmental factors. An early clinical trial in India where over 3000 ‘mildly’ diabetic patients were fed with bread incorporating aloe gel, demonstrated a reduction in blood sugar level to over 90% of the cases (Agarwal, 1985). A survey of patients in Texas showed that 17% of those of Mexican origin used *Aloe vera* in an unspecified way, presumably with satisfaction (Noel et al., 1997). Dried aloe exudates has been used in Arabia in the treatment of diabetes mellitus. Administration to non-insulin dependent human patients in a small trial resulted in a sustained lowering of blood sugar levels (Ghannam et al., 1986). A similar effect was achieved on mice, made diabetic with alloxan treatment (Ajabnoor, 1990). Decreased wound healing that associated with diabetes is a likely subject for aloe gel treatment. It was demonstrated that in rats an *Aloe vera* gel preparation injected subcutaneously promoted diabetic wound healing, reduced abnormal sensitivity to pain and reduced oedema induced by mustard (Davis et al., 1988).

**Anti-cancer activity:**

Agents active against neoplasm are much sought after and aloe preparations are of course the obvious candidates. Whole freeze –dried leaves of *Aloe arborescens* were fed to rats subsequently challenged with either of two carcinogens, an undefined pyrolysis product (the initiative stage) or diethyl nitrosamine (the promotion stage), which are known to act on the liver cells. The initiation stage was somewhat depressed, and there was a significant reduction in tumor promotion (Tsuda et al., 1993).The level of a mouse serum protein, named hemopexin was shown to increase during development of some tumors, implying a defensive
response; aloe exudates stimulates its production. An earlier paper had described antileukemic activity by aloe-emodin (Kupchan and Karim, 1976) and later cytotoxicity of aloe extract was observed against human leukemia cells in culture (Grimaudo et al., 1997). The effect of diethylhexylphthalate (DEHP) from Aloe vera showed positive results on the apoptosis of human leukaemic cell lines K562, HL60 and U937 (Lee et al., 2000). The fresh leaf pulp extract of Aloe vera was examined on carcinogen metabolizing phase−I and phase−II enzymes, antioxidant enzymes, and glutathione content, lactate dehydrogenase, and lipid peroxidation in the liver of mice. Aloe vera significantly reduced the levels of cytochrome P450. Thus, Aloe vera is clearly an inducer of phase-II enzyme system. This suggests its role in protection against pro-oxidant−induced membrane and cellular damage. The microsomal and cytosolic protein was significantly enhanced by Aloe vera, indicating the possibility of its involvement in the induction of protein synthesis. (Singh et al., 2000).

**Antimicrobial effects:**

Infection hinders wound healing perhaps efficacy of aloe gel on wound healing lies in its antibiotic properties (Cera et al., 1980). Antifungal activity has received less attention. Unspecified inhibitory activity was reported against Trichophyton spp. by Aloe ferox ‘juice’ (Soeda et al., 1966). More detailed work demonstrated weak inhibitory activity of Aloe arborescens against spore germination and hyphae growth of Trichophyton mentagrophytes (Fujita et al., 1978 b).

Aloe gel is often included in nutritional supplements used in a clinical trial with acquired immunodeficient syndrome (AIDS) patients, where it was said to be beneficial, without specific side effects being recorded, rather nutritional supplementation was emphasized as being very important (Pulse and Uhlig, 1990). A polysaccharide fraction from aloe gel, the acetylated mannann acemannan, had previously been used to treat AIDS patients. A 71% reduction in symptoms was recorded, perhaps due to stimulation of the immune system (Mc Daniel et al., 1987), although some patients seemed to show no response (Mc Daniel et al., 1988). That is possible because immunity level varies amongst individuals of a population.
Family: Araceae (Arum Family)

Common names: sweet flag (English), rat root, sweet sedge, flag root, sweet calomel, sweet myrtle, sweet cane, sweet rush, beewort, muskrat root, pine root, bacha (India).

Related species: *Acorus americanus*,

*Acorus calamus*, one of the members of the Araceae, is a semi-aquatic herb, which is distributed throughout the temperate to sub-temperate regions of the globe. The plant has a rich ethno botanical history dating back possibly to the time of the Moses in the Old Testament of the Bible and in early Greek and Roman Medicine. The sweet flag may have its origin in India and were introduced into Latin America and Europe. It spreads along the trade routes and, has been valued for its rhizome and fragrant essence for perfumes oils, and insecticidal properties (Motley, 1994).

*Acorus calamus* is a monocotyledonous wetland plant that can withstand extremely long periods of anoxia and a competitive invader at eutrophic sites. (Bucher and Kuhlemeier, 1993; Joly, 1995). It shows remarkable tolerance of anoxia in both shoots and roots. It is also able to mobilise carbohydrate and maintain ATP level during anoxia as well as preserves membrane lipids against anoxic and post anoxic injury (Crawford, 1996).

**Description:**

Sweet flag resembles iris and is a rhizome bearing, perennial plant. This species inhabits perpetually in wet areas like the edges of streams around ponds and lakes, in ditches and seeps. The plants have long creeping roots that spread out just below the surface of the soil. These roots spread horizontally and can grow to almost 2 meters in length, for old and well-established specimens. From the rhizomatous roots new plants grown up from adventitious buds. The thick, erect leaves are very similar in appearance to those of an iris, but with edges that are crimped. Plants very rarely flower or set fruit, but when they do, the flowers are 3-8 cm long, cylindrical in shape, greenish brown and covered in a multitude of rounded spikes. The fruits are small and berry-like, containing few seeds. Flowers appear from early to late summer depending on the latitude.
Important flower development features include an abaxially median tepal that is initiated first and is similar to a flower-subtending bract. Unidirectional flower development takes place with an inversion of organ initiation sequence in the second tepal whorl. The mature gynoecium is largely synascidiate, but early development of carpels is plicate, and the apocarpous portion persists up to anthesis. The carpels from the dorsal side bulges out on the style, enclosing longitudinal intercarpellary slits. The dominance of synascidiate portion and the apical position of the placenta result from a late and distinct basal elongation of the gynoecium. Stigma, pollen transmitting tract, and ovary are filled with secretion. Secretory papillae are present from the stigma to the placenta; papillae also occur on the rims of the integuments of the ovules. In the upper most part of the inflorescence, the adaxial floral sectors are reduced in number and structure, and at the apex of the inflorescence, a peloria-like structure is formed. Developmental and morphological similarities seem to be closer between *Acorus* and members of Piperales than between *Acorus* and other Magnolids. (Buzgo and Endress, 2000).

Seasonal variation in the nitrogenous reserves is also reported. (Weber and Braendle, 1994). Roots, rhizomes and leaves are not of equal importance with respect to nitrogen storage. Because of its high biomass, most nitrogen is stored in the rhizome. However the biomass is lower in winter. Roots survive severe winter. In the rhizome, high amounts of arginine, asparagine and proteins are present in winter. Also asparagine is the predominant amino acid in winter leaves. Alanine accumulates in roots when plants are submerged. Arginine seems not to be translocated in large amounts out of the rhizome into expanding leaves. Analysis of bleeding sap showed hardly any arginine but elevated concentrations of asparagine and glutamine. With respect to nitrogen cycling *Acorus calamus* is a combination of the translocation type and the assimilation type.

**Cultivation parameters:**

*Acorus calamus* is a hardy easy to grow plant. New plants always start from root cuttings. At least a 5-6 cm piece of root, preferably firm, clean and aromatic, and free from any damage or infection is used. Plants can be divided in the fall for spring transplanting. It loves moist places. This plant grows almost anywhere as long as there are adequate amounts of water present, and has ample sunshine.
Active constituents:

Monoterpene hydrocarbons, sequestrine ketones, (trans- or Alpha) asarone (2,4,5-trimethoxy-1-propenylbenzene), and beta-asarone (cis-isomer) and essential oils are found in sweet flag rhizomes. (Oprean et al., 1998 a, b). The American variety has consistently tested for carcinogenic beta-asarone and is found to be free of it but the Asian varieties do contain varying amounts of beta-asarone. It causes a more sedate feeling when ingested. European varieties of sweet flag have yielded various sesquiterpenoids having psychoactive or medicinal properties.

Traditional medicinal uses:

Most of the uses of calamus roots are known from American tribes. The Indians of Northern Alberta use calamus roots for a number of ailments, such as an analgesic for the relief of toothache or headache, for oral hygiene to cleanse and disinfect the teeth, to fight the effects of exhaustion or fatigue, and to help cure prevent a hangover. Other native tribes in America used it to treat cough, made a decoction as a carminative and as an infusion for cholic. The Dakotas use calamus to treat diabetes, and there are several reported cases where the root had cured people who had been given up by Western medicine. When calamus root was chewed regularly by the Indians, they would be miraculously cured of this disease within a matter of months. The Sioux used the whole plant, making aromatic garlands from the leaves, and using the root as a tea for bowel pains, or rubbed the chewed root on the skin for a general illness cure.

Sweet flag has been used in Asia for at least the last 2000 years for a number of beneficial reasons. The ancient Chinese used it to lessen swelling and for constipation. In India, Ayurvedic medical practitioner has used the magical root to cure fevers, asthma and bronchitis, and as an all around sedative. The root was also used by the ancient Greeks and included in the traditional remedies of many other European cultures. During the middle ages calamus was an admixture in several of the ancient, psychoactive, “witches flying ointments”, often being mixed with solanaceous herbs. The root was also well known in Biblical times and mentioned in Exodus 30: 22-25 as one of the ingredients of the “holy anointing oil”.

Calamus was also widely used by Canadian trappers working for the Hudson Bay Company, using it as a stimulant, and chewing a small piece whenever they were tired. The unpeeled, dried rhizome was listed in the U.S. Pharmacopoeia until 1916 and in the National Formulary until 1950, for medicinal use on humans. Health hazards: Long-term use of high doses of Calamus produced carcinogenic effect in rats.

Modern findings:

The ethanolic extract of *Acorus calamus* showed significant anti-secretory and anti-ulcerogenic activity in rats. The extract had highly significant protective effect against cytodestructive agents (Rafatullah et al., 1994). Mammalian toxicity and carcinogenicity of asarones has been demonstrated by other researchers (McGaw, 2002).

Alcoholic extracts of rhizome of *A. calamus* growing in KwaZulu-Natal, South Africa were previously found to have anthelmintic and antibacterial activity. The phenylpropanoid b-asarone was isolated from the rhizome. It has previously been isolated from *A. calamus*, and a related species, *A. gramineus*. This compound was shown to possess anthelmintic and antibacterial activity (Rajendhran, 1998). The rhizome powder has also been reported to be effective against powdery mildew (Singh and Upadhyay et al., 1999). Different varieties of *A. calamus* exhibit different levels of b-asarone, with the diploid variety containing none of the compound. *Acorus calamus* is used in waste water management of rural areas, which are not served by sanitary sewers (Antonious and Warner, 2000).

The essential oil of Indian *Acorus calamus* (L.) is a potential pest control agent. Its active ingredient beta asarone has toxic effect and reduces the feeding activity of the insect up to 83% (Tiwari, 1993, 1994; Singh and Upadhyay, 1993; Schmidt and Streloke, 1994; Wawrzyniak, 1996; Chander et al., 1999.) Petroleum ether extract of *Acorus calamus* displayed significant mosquito larvicidal activity against late 3rd instars culex larvae. High mosquito larvicidal activity was observed in the steam distillate of *Acorus calamus* (Ranaweera, 1996). In the search for germination inhibitors from plant sources, the methanol extract of *Acorus calamus* was shown to inhibit germination of lettuce seeds. Compounds isolated-sesquiterpenes and have cadinane, acorone and eudesmane skeletons. These compounds showed potent anti-germination activity. (Nawamaki and Kuroyanagi, 1996).
**Withania somnifera** Dunal.

**Family- Solanaceae**

**Common name-** Aswagandha, Indian Ginseng

**Distribution-**

*Withania somnifera* Dunal is distributed in dry warm regions of North India. It is one of the major medicinal plants that are under cultivation in MP and Rajasthan; over 4000 hectares are under Ashwangandha cultivation (Merillon and Ranawat, 1999).

**Description-**

*Withania somnifera* is a branched erect undershrub 0.3-1.5 m high having terete branches that are usually clothed with stellate hairy tomentum. Leaves (5-10 cm by 2.5-5.0 cm) are ovate, sub acute entire. Flowers are greenish or yellow usually about 5 together in a sessile or nearly sessile umbellate cyme. Fruit is a berry, red smooth, and 6 mm in diameter enclosed in the persistent inflated calyx. Seeds are 2.5 mm in diameter, reniform yellow somewhat scurfy. Roots are stout fleshy whitish brown. Adult plant roots mimic a human form. Plants are propagated by seeds.

The plant bears flowers and fruits in December. Harvesting starts from January and continues till March. The entire plant is uprooted for roots, which are separated from aerial parts by cutting the stem 1-2 cm above the crown. They are then transversely cut into smaller pieces for drying. The main root bears fiber like secondary roots. Roots have a strong odour and mucilaginous. They taste is bitter (Wealth of India, 1950).

**Phytochemical studies-**

Power and Salway (1911) carried out the first scientific investigations on the constituents of this plant. From the roots some nitrogen containing components and withanol were isolated. From the leaves, somnirol and somnitol were isolated. Majumdar and Guha (1933) isolated and characterized several nitrogenous bases, seven amorphous bases and nicotine from the roots. In the course of investigation for alkaloids of the roots of *Withania somnifera*, Schwarting *et al.*, (1963) reported the presence of tropine, pseudotropine, 3 α-trigloyloxytropane, choline, cuscohygrine, isopelletierine, anaferine, and anahygrine. WithaferinA (4 β, 27-di-hydroxy-1-oxo-5β, 6β-epoxy-22 R -witha-2, 24-
dienolide) is the first compound to be isolated from this well-known Indian medicinal plant. Its structure was fully elucidated (Lavie et al., 1965). Lavie et al (1968) identified the major component withanolide –D from the leaves of Withania somnifera growing in Israel. It was found to be isomeric with Withaferin –A. Withanolide –D was then identified as 5,6β-epoxy-4 β, 20 α-dihydroxy-1-oxo- (5β) witha–2,24-dienolide.

Pharmacological importance:

Withania somnifera is a very valuable and popular Ayurvedic and Unani medicinal plant. The active constituents possess antistress, anti-inflammatory (Budhiraja et al., 1984.), antitumor (Sharada et al., 1996.), antibiotic, anticonvulsant, antimicrobial (Chatterjee and Chakraborty, 1980) immunomodulatory and CNS depressant activities (Sharma and Dandiya, 1992). Among its constituents withaferin A showed antibacterial activity. It is active only against Gram-positive bacteria and non–filamentous fungi (Chatterjee and Chakraborty, 1980). Antifungal activity of withaferinA against Aspergillus flavus, Epidermophyton floccosum and Cladosporium herbarum was also reported (Sethi and Khosa, 1975). It also showed cytotoxicity against KB cell cultures. Withaferin A also showed significant inhibitory activity against Sarcoma 180 tumor in mice and Walker intramuscular carcinosarcoma 256 in rats (Kupchan et al., 1969). It exhibited significant growth retardation of EAC in mice i.p. administration of a single dose of Withaferin A (25-40 mg/kg) 24 hr after EAC implantation, decreased the growth of the tumor, which subsequently disappeared in 80% of mice (Shohat et al., 1970). It has been reported to act as a mitotic poison and arrest the division of cultured human larynx carcinoma cells at metaphase (Shohat et al., 1969). Besides Withaferin A other structurally related withanolides have been reported to have cytotoxic activity. They are 4β-hydroxywithanolide E, withanolide E, withanolide D, and the trans diequatorial chlorohydrin of Withaferin A (Ray and Gupta, 1994). Different withanolides were tested for antineoplastic activity. Among the tested compounds, 4β-hydroxywithanolide E exhibited the most promising activity against B 16 melanomas and L-1216 leukemia. Budhiraja et al., (1984) demonstrated the anti-inflammatory activity of 3β-hydroxy 2,3- dihydrowithanolide F by testing against subacute models of inflammation and claimed its effect to be comparable to that of hydrocortisone. The compound has been
reported to be superior to hydrocortisone in its activity and as a hepatoprotective agent against CCl₄-induced liver damage (Budhiraja et al., 1986).

The withanolides possess both immunosuppressive and immunostimulating properties. Inhibition of growth of EAC in mice followed by complete disappearance of tumor cells on withaferinA treatment and resistance of the cured mice to rechallenge with EAC indicates the immunoactivating properties of withaferinA (Shohat et al., 1970). The immunosuppressive activity of withaferinA is evident from its ability to inhibit arthritis in rats (Fungner, 1973). Similar action was also shown by withanolideD. The glycosides were shown to exhibit adaptogenic and immunostimulatory activity. They produce significant antistress activity in albino mice and rats and augmented learning acquisition and memory retention in young and old rats (Ghosal et al., 1989). They also alleviated the adverse effect of morphine (Rama Rao et al., 1995). Withania somnifera is used as an adjuvant during radiation therapy (Kuttan, 1996).
**Eupatorium ayapana Vent**

**Family:** Asteraceae  
**Species:** Eupatorium triplinerve Vahl. syn. Eupatorium ayapana Vent.  
**Vernacular names:** Sanskrit-Ajapama. Visalyakarani. Hindi and Bengali-Ayapana. Tamil-Ayapani.

The Eupatorium genus is one of the most important plants used in herbal medicine.

**Distribution:**

Eupatorium ayapana Vent, is a native of Brazil and has long been naturalized in India.

**Description:**

It is an aromatic under shrub, 3-4 feet high with trailing stems rooting at all nodes. Erect sprawling shrubs. Leaves alternate, subsessile lanceolate, margins sub-entire to lobed. Flowers are borne in capitula, involucre ovate to campanulate, corolla of ray floret with expanded lamina, flowers and fruits-March –May. It thrives on any ordinary soil under partial shade at low or medium elevations and is easily propagated by cuttings or suckers.

**Chemical constituents:**

7-Methoxy coumarin [ayapanin], 6,7-dimethoxy coumarin [ayapin]; carotene, vitamin-C and stigmasterol were isolated from its leaves (Bose and Roy, 1936). Five additional coumarins, viz. daphnetin, daphnetin dimethyl ether, hydrangetin, daphnetin -7-methyl ether and umbelliferone have been isolated (Chaturvedi and Mulchandani, 1989). The leaves possess a coumarin like odour and yield a pale green essential oil on steam distillation. The principal constituent of the oil is thymohydroquinone, dimethyl ether, sesquiterpene, and traces of coumarin.

**Therapeutic uses:**

Whole plant is used as antiperiodic, cardiac stimulant, diaphoretic, diuretic, emetic, expectorant, tonic, infusion useful in ague, cough, and dyspepsia. The leaves (fresh bruised) applied to scores, snakebite and foul ulcers. The juice of the fresh leaves is digestive agent.
and haemostatis (Bose and Sarkar, 1937). *Eupatorium ayapana* is considered as the most powerful therapeutic agent. A decoction of the leaves has been used as a popular remedy against various kinds of hemorrhage. If it is given internally as an antidote to snake bites, it is considered a sure remedy—if timely used. It is an antidote against the bites of other poisonous reptiles and insects. In Europe, the dried leaves of the plant were used as a tonic under the name of ‘Ayapana tea’. The coagulation time of rabbit’s blood was diminished when traces of finely divided ayapanin or ayapin were added *in vitro* (Bose and Sarkar, 1937; Bose and Sen, 1941). Both ayapanin and ayapin are non-toxic and are effective when applied locally or when administered by subcutaneous injections or by mouth. They have no effect on respiration or on blood pressure (Wealth of India 1950).
REFERENCES


SCIENTIFIC UTILITY OF THE WORK

Since prehistoric days attempts are being made to find out suitable drugs from natural sources for the treatment of different diseases. The rational approaches, experience of folk medicine provide a valuable approach, in the search for the development of new and useful therapeutic agents.

The living plant cell possess a highly organized structure with various organelles having distinct biochemical characteristics. It is to the secondary plant products (i.e. those not necessarily involved in the essential metabolism of the cell) that the majority of the vegetable drugs owe their therapeutic activity. So, pharmacognosists are particularly interested in plants. Recently, considerable attention has been directed to the possible ecological implications of secondary metabolites not only in relation to plant-plant interaction but also concerning the interrelationship of plants and animals. At the same time conservation of economically important plants is of prior importance, for ecological balance as well as proper exploitation. Raising tissue culture raised plants is an important aspect, for rapid micro propagation, disease resistant plants and higher yield of useful secondary metabolites for pharmacological activities.

Synthetic drugs are not only costly, but also possess various major and minor side effects. On the contrary, drugs from herbal origin having fewer side effects. They are easily available to the common people. Therefore the first and the most important research is to identify newer more potent less toxic bioactive molecules. Their chemical characterization mechanism of action and therapeutic efficacy are to be worked out in order to establish low cost potent medicine.
BRIEF OUTLINE OF THE WORK

The work incorporated in this thesis is mainly divided into nine chapters.

The first chapter deals with micropropagation of *Aloe vera*. The study of chromosomes of both the cultivated and the tissue cultured raised plants.

In the second chapter, the isolation of the marker elements from these four plants is included.

In the chapter three, antimicrobial study of all the plants were done with both Gram (+) and Gram (−) bacteria and with pathogenic fungi by the method of zone of inhibition on solid nutrient agar plates after 24 hours of incubation and 48 hours of incubation.

In the chapter 4, LD$_{50}$ of the two plants *Aloe vera* and *Eupatorium ayapana* are done.

In chapter five, anticancer activity of *Eupatorium ayapana* and *Aloe vera* from *in vivo* and *in vitro* grown plants were studied.

In chapter six, hepatoprotective action of *Eupatorium ayapana* and *Aloe vera* were studied.

In chapter seven, the effects of the extracts of *Eupatorium ayapana* and *Aloe vera* from both *in vivo* and *in vitro* grown plants on hematological parameters were studied.

In chapter eight, effects of the extracts on liver function and metabolism in mice was studied.

Chapter nine, deals with the effects of the extracts on kidney function in mice.

In the concluding chapter, the results and conclusions from all the chapters were clearly focused.