Chapter II
REVIEW
OF
LITERATURE
Review of Literature

Mankind has always been under threat of diseases and ailments. To cure such diseases, nature has gifted various plants to humans. The knowledge of drugs has accumulated over thousands of years as a result of man’s inquisitive nature. In the past, almost all the medicines used were from the plants, the plant being man’s only cure for ages even today. In 1985, the World Health Organization (WHO) estimated that about 80% of the world’s populations still rely mainly on traditional remedies such as on herbs for their primary health care needs (Farnsworth et al. 1985).

The history of herbal medicines is as old as human civilization. The documents, many of which are of great antiquity, revealed that plants were used medicinally in China, India, Egypt and Greece long before the beginning of the Christian era. Most of the medicinally active substances identified in the nineteenth and twentieth centuries were used in the form of crude extract. In China, many medicinal plants had been in use since 5000 B.C (Lee, 1949).

A large portion of the Indian population even today depends on the Indian system of medicine – Ayurveda. The well known treatises in Ayurveda are Charaka Samhita and Sushruta Samhita. Sushruta arranged 760 herbs in 7 distinct sets based on some of their common properties. Ayurvedic medicine stresses that psychic influences strongly affect the body in health as well as disease, a fact which must also be taken into account in modern therapeutics (Pizzorno and Murray, 1999; Ahmad et al. 2006; Khare, 2007).

Plants are the source of many modern medicines. It is estimated that approximately one quarter of prescribed drugs contain plant extracts or active ingredients obtained from or replica of plant substances. Considerable modern research has proven the efficacy of Ayurvedic herbal preparations and research has now moved to elucidating their mechanisms and sites of action. The most popular analgesic, aspirin, was originally derived from species of Salix and Spiraea and some of the most valuable anti-cancer agents such as paclitaxel and vinblastine are derived solely from plant sources (Katzung, 1995; Pezzuto, 1996; Roberts, 1988). Digoxin, codeine, colchicine, morphine, vincristine and yohimbine are some popular examples of plant compounds. Current estimates show that more than $11 billion of plant-based medicines are purchased each year in the US alone and $43 billion worldwide (Principe, 1989). The scientific investigation of plant medicines is replacing some of the mystery and romance of herbalism with a greater understanding of the ways in which herbs work. It is quite apparent that many of the “wonder drugs” of the future will be derived from plants or plant cell cultures and from compounds naturally occurring in the human body produced by cell cultures (e.g. interferon, interleukin-II, various hormones, etc.).

Many books and review articles are published till date which synchronized the synonyms and medicinal properties of Indian medicinal plants (Chopra et al. 1956; Kirtikar and Basu, 1975; Anonymous, 1986; Sharma, 1991; Husain, 1992; Chunekar and Pondel, 1999; Khare, 2007) also the number of other publications like The Ayurvedic Pharmacopoeia of India (Vol. I to IV); Standard Nomenclature of Ayurvedic Medicinal Plants (CCRAS, 1999); Medicinal Plants used in Ayurveda (Rashtriya Ayurveda Vidyapeeth / National Academy of Ayurveda, 1998); Natural Medicines Comprehensive Database, 2007.
Medicinal plants and herbs have proven to be an abundant source of biologically active compounds, many of which have been the basis for new pharmaceuticals. Some group of plants is producing similar or different types of pharmaceutically active compounds which are responsible for the curing of particular disease. Thus some of medicinal plants could be classified under one or more pharmacological heading since they exhibit one to many different actions on human beings.


In the folklore of Indian medicine, certain herbs have been used traditionally as brain or nerve tonics. In ayurvedic medicine system these plants are classified as “Medhya Rasayana” which promotes the memory and intellectuals. Some of the medicinal plants acting on nervous system includes *Bacopa monnieri* (Jorm et al. 2004 and Nathan et al. 2004), *Centella asiatica* (Shukla et al. 1989 and Rao et al. 1996), *Withania somnifera* (Nadkarni, 1976; Singh, 1982 and Ghosal, 1989), *Celasirus panniculatus, Convolvulus pluricaulis* (Ganju et al. 2003; Kumar 2006), *Evolvulus alsinooidis, Nordostachys jatamansi, Embalica officinalis* (Satyavati, 1976; Sharma, 1978; Scarazzini, 2006) and *Ocimum sanctum* (Bhargava and Singh 1981; Jha, 2001). Kumar (2006) and Husan et al. (2007) extensively reviewed medicinal plants used in brain disorders.

*B. monnieri, C. asiatica* and *C. pluricaulis* are the three important medicinal plants used as brain tonic to improve mental health and learning ability in almost all the herbal medicine system. Herbal formulations of these plants are available in the market either in combination or single drug form.

One of the most popular of these neurotonics is *Bacopa monnieri*, a small, common, amphibious plant growing in marshy areas throughout the Indian subcontinent. *B. monnieri* is also called Brahmi, a name derived from Brahma, the creator God of the Hindu pantheon of deities. In the Ayurvedic materia medica, *B. monnieri* has been recognized for its brain-enhancement characteristics (Sharma, 1987; Singh and Dhawan 1997). It is said that the use of *B. monnieri* for memory enhancement goes back 3000 years or more in India, when it was cited for its medicinal properties, especially the memory-enhancing capacity, in the Vedic texts *Athar-Ved Samhita* (3:1) of 800 B.C. and in Ayurveda (Sekar, 1996).

Certain phytoactive substances of *B. monnieri*, called bacosides A and B, help repair damaged neurons by enhancing proteins involved in the regeneration of neural-cell synapses (Rastogi et al. 1994). In addition to the bacosides A and B already mentioned, *Bacopa* contains a wide variety of medically active substances, including stigmasterol, sapogenins and flavonoids. Other compounds include triterpenoid saponins and other alkaloids (nitrogen-based organic substances), such as brahmine.
and herpestine. *Bacopa* also contains D-mannitol, betulic acid, beta-sitosterol, octacosane, nicotine and amino acids such as alpha-alanine, aspartic acid, glutamic acid and serine (Ganguly, 1969; Shukla, 1987). Each of these ingredients imparts its own special enhancements, as a review of the literature shows.

Among its many other applications, *Bacopa* has reportedly been effective in reducing anxiety levels, thereby allowing for further improvement of brain functioning and elevated mental performance. It is also believed to help stabilize the brain waves of epileptics. As well, *Bacopa* is recognized as a treatment for asthma, bronchitis, and hoarseness. In other parts of the body, it has been used successfully as a remedy for rheumatism, diarrhea, and as a diuretic (increasing urinary flow) (Ganguly, 1967; Singh and Singh 1980; Singh and Dhawan 1982; Jain, 1994, Tripathi et al. 1996).

In Ayurveda *Centella asiatica* is one of the chief herbs for revitalizing the nerves and brain cells (Apparao et al. 1973). The key constituents of plants are saponins asiaticoside, brahmoside, brahminoside, thankuniside, madecasicacid), alkaloids (Hydrocotyline), bitter principles (Vellarin) (Atihal and Sirsi 1961; Shrivastava et al. 1997; Joseph et al. 2001). Arora et al. (1998) reviewed the medicinal uses and pharmacological action of *C. asiatica*. Malhotra et al. (1961) carried out the chemical and pharmacological studies of *C. asiatica*. Srivastava (1997) showed the antimicrobial activity of *C. asiatica*. Cytotoxic and anti-tumour properties of *Centella asiatica* were demonstrated by Babu et al. (1995). Edwin et al. (2000) studied on the antimutagenic effects of *C. asiatica*. Bhattacharya (1956) examine the constitution of the Indian variety of *C. asiatica*.

*Convolvulus pluricaulis* a twining perennial is one of the very well known medicinal plant use as brain tonic (Gopalakrishna, 1976). Chemical studies of the whole plant have shown the presence of glycosides, coumarins, flavonoids and alkaloids (Rakhit and Basu 1958; Singh et al. 1988). Sankhpushpine has been identified as active principle of the plant. β - Sitosterol, hydroxyl cinnamic acid, octacosanol tetracosane also have been isolated from the plant. Joshi et al. (1995) studied effect of *C. pluricaulis* on biogenic amine levels in rat brain. Antifungal effect of *C. pluricaulis* was shown by Gupta et al. (1974).

The technique of plant cell culture plays a key role in the gene modifications and biotechnology which are being used to improve crop yields and quality. This technology has become an important tool for understanding the basic and applied problems in plant biology. This state of art technology has becomes possible by continuous efforts of many scientists.

The concept of plant cell and tissue culture was conceived by Haberlandt in 1902 when he attempted to culture leaf of *Lamium pupureum* on an artificial medium, with a view to develop tissue cultures and eventually, regenerate a whole new plant. For about two to three decades after Haberlandt's work very little was heard of plant cell culture. Robbins (1922) was the first to develop a technique for the culture of isolated roots. White in (1934) established continuous growing root cultures of *Lycopersion esculantum*, Gautheret (1938) of *Salix purpurea*, *Populus nigra* and others trees.

The period of 1936 – 1956 was the period of exploration and innovation in approach and techniques, which provided model system for experimentation concerned with
physiology of nutrition, growth and morphogenesis. This gave rise to the formulation of a number of artificial nutrient media. Since then considerable progress had been made in the field of nutrient media. Notable among them are White (1934, 1954); Nitsch (1951); Heller (1953); Murashige and Skoog (1962); Gamborg et al. (1968); Chu (1978) etc.

During this period root cultures drew the attention to the role on vitamins in tissue growth and the advanced the knowledge of the shoot-root relationship (Street, 1959; 1966). In 1941, it was demonstrated the coconut milk which normally nourishes the developing coconut embryo, providing factors which would encourage the growth of young, excised Datura embryos (Van Overbeek et al. 1941). The studies of Camus (1949) led to important studies on factors controlling vascular tissue differentiation (Wetmore and Sorokin, 1955; Wetmore and Rier, 1963). The work of Miller and Skoog (1953) on bud formation from cultured pith explants of tobacco led to the discovery of kinetin. Following this, the first notable success in the area of hormonal regulation of growth and differentiation came from the work of Skoog and Miller (1957) on tobacco pith cultures by manipulating auxin-cytokinin combinations in the nutrient media. Muir et al. (1954) reported that if fragments of callus of Tagetes erecta and Nicotiana tabacum were transferred to liquid medium on a gyratory shaker, the fragments break up to give a suspension of single cells and cell aggregates. Torrey et al. (1962) studied mitosis in cell suspension culture procedure.

The first report of somatic embryogenesis was however, from carrot root tissue by Reinert (1958) and Steward (1958) and subsequently of leaf mesophyll cells of McCleaya Cordata by Kohlenbach (1966). Guha and Maheshwari (1964) reported the development of haploid embryos in anther culture of Dature innoxia and subsequently confirmed their origin from pollen grains (Guha and Maheswari, 1966).


The micropropagation industry has been tremendously expanding all over the world in last two decades in number of production units as well as in the number of plants produce annually. In India this industry started late but expanded exponentially from 1987 to 1993 (Govil and Gupta 1994). Significant of tissue culture of medicinal plants are well reported by Roberts, 1988; Fay, 1992; Nehra et al. 1994; Narayanaswamy, 1997; Kumar, 2000; Saxena et al. 2000; Tripathi and Tripathi, 2003; Devi, 2004).
Numerous factors are reported to influence the success of in-vitro propagation of different medicinal plants (Roy et al. 1994; Paek et al. 1995). Clonal propagation can be achieved through rapid proliferation of shoot tips and axillary buds in culture (Tejavathi et al. 2001). Rout et al. (2000) reviewed influence of different factors during in vitro regeneration of plants.

The effects of auxins and cytokinins on shoot multiplication of various medicinal plants have been reported. 6-Benzylaminopurine at high concentration stimulates the development of the axillary meristems and shoot tips of *Atropa belladona* (Hussey, 1980). Lal et al. (1996) observed a rapid proliferation rate in *Picrorhiza kurroa* using kinetin at 1.0–5.0 mg/l. The effect of growth regulators and their interactions on propagation of different medicinal plants have been reported by Catapan et al. 2000; Ramual et al. 2002. It has been observed that cytokinins are required, in optimal quantity, for shoot proliferation in many genotypes but inclusion of low concentration of auxins along with cytokinins triggers the rate of shoot proliferation (Borthakur et al. 2002; Rai, 2002).

Plant regeneration from shoot and stem meristems has yielded encouraging results in medicinal plants like *Catharanthus roseus*, *Cinchona ledgeriana* and *Digitalis* sps., *Rehmannia glutinosa*, *Rauvolfia serpentina*, *Isoplexis canariensis* (Withers, 1986; Skirvin 1990).

Plant regeneration via somatic embryogenesis from single cells, that can be induced to produce an embryo and then a complete plant, has been demonstrated in many medicinal plant species. Arumugam and Bhojwani noted the development of somatic embryos from zygotic embryos of *Podophyllum hexandrum* on MS medium containing 2 μM BA and 0.5 μM IAA (Arumugam and Bhojwani, 1990). Embryogenic calluses and germination of somatic embryos in nine varieties of *Medicago sativa* has been achieved (Fuentes, 1993). Using a medium containing 2,4-Dichlorophenoxyacetic acid and TDZ, Zhou et al. (1994) have achieved the induction of somatic embryogenesis in cells from *Cayratia japonica*.

Plants are the traditional source of many chemicals used as pharmaceuticals. Most valuable phytochemicals are products of plant secondary metabolism. Excellent reviews on the subject of secondary metabolites and their production through cultures have been reported (Nickell, 1962; Carew and Staba, 1965; Puhan and Mitra, 1971; Stohas and Rosenberg, 1975; Butcher, 1977; Chadda and Heble, 1980; Bohm, 1980; Khanna, 1982, 1984; Staba, 1963; Christian and Saxena, 2005; Vanisree et al. 2004; Sarin, 2005; Shinde, 2008). Product reviews have been written very efficiently by Staba, 1963, Corduan, 1975 on alkaloids biosynthesis and Stohs and Resenberg (1975) on steroids and steroidal metabolism in plant tissue culture and numerous reports are available describing the production of different secondary metabolites, viz. alkaloids, saponins, steroidal alkaloids, coumarins and several others (Tabata, 1977; Gaur, 1978; Singhvi, 1979; Bohm, 1978; Gupta, 1981; Zafar et al. 1992; Thorpe, 1994; Ramawat and Merillon, 2000; Kumar, 2002; Christian, 2004; Mulabagal, 2004; Haq, 2005, Rathod, 2006).

The production of solasodine from calli of *Solanum eleagnifolium* and pyrrolizidine alkaloids from root cultures of *Senecio* sp. are examples (Toppel et al. 1987). Cephaelin and emetine were isolated from callus cultures of *Cephaelis ipecacuanha* (Jha et al. 1988). Scragg (1992) isolated quinoline alkaloids in significant quantities.
from globular cell suspension cultures of *Cinchona ledgeriana*. Enhanced indole alkaloid biosynthesis in the suspension culture of *Catharanthus roseus* has also been reported (Zhao et al. 2001).

Ravishankar and Grewal (1991) reported that the influence of media constituents and nutrient stress influenced the production of diosgenin from callus cultures of *Dioscorea deltoide*. Parisi et al. (2002) obtained high yields of proteolytic enzymes from the callus tissue culture of garlic (*Allium sativum* L.) on MS medium supplemented with NAA and BAP. Pradel et al. (1997) observed that the biosynthesis of carotenoids was maximal in the hairy root cultures of *Digitalis lanata* compared to leaf. The production of azadirachtin and nimbin has been shown to be higher in cultured shoots and roots of *Azadirachta indica* compared to field grown plant (Srividya and Devi, 1998). Pande et al. (2002) reported that the yield of lepidine from *Lepidium sativum* Linn depends upon the source and type of explants.

Scrugg et al. (1990) isolated serpentine from *Catharanthus roseus*. Kundu and Sarkar (1991) identification a new alkaloid from the seed of *Datura metel* Linn. Rasoaainaivo et al. (1994) extracted alkaloids from plants of Madagascar which were found to be resistant against *Plasmodium* malaria.


Callus culture of *Papaver rhoeas* Linn. established on revised tobacco medium showed presence of three opium alkaloids namely morphine, thebaine and narcotine (Sarin, 2003). Shrishailappa et al. (2003) studied the antitumor activity of total alkaloid fraction of *Solanum pseudocapsicum* leaves. Saifah et al. (2004) isolated two new isoquinolone alkaloids named sauropine A and sauropine B from *Sauropus hirsutus* and confirmed the presence of isoquinoline alkaloids as the major constituents in a *Sauropus* species.

Berkov and Pavlov (2004) developed a rapid and convenient method for sample preparation and simultaneous densitometric quantification of hyoscyamine and scopolamine using TLC-densitometry. An alcoholic extract and the total alkaloids obtained from the leaves of the plant *Tylophora indica* were studied for their pharmacological effects by Dhananjayan et al. (1975). A rapid method enabling a quantitative analysis of thebaine in capsules and latex of *Papaver bracteatum* has been devised, based on a TLC technique by Lavie et al. (1979). Paiva and Janick (1983) studied in vivo and in vitro production of alkaloids in *Theobroma cacao* L. using liquid chromatography (HPLC).

The potential of non-aqueous capillary electrophoresis was investigated for the separation of isomeric tropane alkaloids from *Schizanthus grahamii* by Humam et al. (2005). Das et al. (2005) developed a method for the simultaneous determination of the pharmacologically important quinazoline alkaloids vasicine and vasicinone in *Adhatoda vasica*. Suvi et al. (2005) studied tropane alkaloids in *Nicotiana tabacum*.

The important function of the flavonoids in the plant is to impart colour to flowers and fruits and a correlation between flower colour and attraction of insects for pollination. Flavonoids have anti-virus, anti-inflammatory and cytotoxic activities and used in the treatment of capillary fragility, retinal hemorrhage, hypertension, diabetic retinopathy, rheumatic fever, arthritis and anti-tumour (Tripathi and Rastogi 1981).

Researches on flavonoids have been conducted both in vivo and in vitro tissue cultures. Kaempferol, quercetin, isorhamnetin, herbacetin, β-methyl ether have been reported from Zygophyllaceous plants (Saleh and Hadidi 1977). Free quercetin along with bound kampferol in leaves and flowers of *Circlis colocynthis*, *C. depressus*, *Fagoma cretica* and *Lycium barbarum* and tissue culture of *Peganum harmala* have been reported (Harsh 1982).

Flavonoids inhibit aldose reductase, the enzyme involved in glycosylation, preventing sorbitol from entering the cell which causes swelling complication in diabetes (Chaudhry 1983). Flavonoids contents of *Stevia neptifolia*, quercetin was found to be the major glycoside (Rajbandari and Roberts 1984). Amino-ethanol-diphenylborate-DEG-400 reagent can be used for flavonoids determination (Brasseur and Arqenot, 1986).

Pathak and Manral (1987) have reported 3-flavonec- glycosides and a flavonol identified as isovitexin from the leaves or *Polygonum amplexicaule*. Mathur and Kavita (1988) reported the presence of quercetin and kaempferol from the leaves and fruits of *Bergia odorata, Eclipta alba* and quantitatively estimated them Flavonoids contents from the leaves of *Ginkgo biloba* by HPLC was studied by Hasler et al. 1992. Hau et al. (1994) observed cytotoxic flavonoids from the leaves of *Melicope triphylla*. Isolation and structure elucidation of flavonoid constituents was carried out in peppermint (*Mentha pipertia*) by Karuza et al. (1996). Ferreres et al. (1997) observed the acylated flavonol glycocides from spinach leaves (*Spinacia oleracea*). Ten highly oxygenated flavonoids, including four new compounds were isolated from the leaves of *Dancy tangerine* (Chen and Montanari 1998). Neo-flavonoids were identified from *Polygonum perfoliatum* (Sun and Sneden 1999). HPTLC method for densitometry detection has been used to determine the flavonoid contents form the leaves of *Vaccinium myrtillus* by Smolarz-Helena et al. (2000). Males and Medic (2001) observed the flavonoids and phenolic acids from *Helleborus atrorubens*. Identification and isolation of flavonoid contents from the leaves and flowers of *Acacia nilotica, A. senegal, Maytenus emarginata* was conducted by Shahid (2002).

flavonoids from *Pongamia pinnata* fruits. While Zhong Yao Cai (2004) reported flavonoids from its stem bark.

Steroids have been always a fascinating subject because of its diversified physiological and pharmacological effects on plants and animals. The works on the production and biochemistry of steroids have been reviewed by many workers (Haeflmann and Mosetting 1960; Chkravarthy et al. 1970; Khanna 1977, 1982, 1985, 1987; Kaul and Staba 1968).

Steroidal drug which has low cost with great therapeutic value and fewer complicating side reactions can be prepared by chemical and microbiological methods is given by Nakanishi et al. (1974). Stohs and Rosenberg (1975) explained metabolism of steroids in plant tissue culture. β - sitosterol, stigmasterol have been reported from *Datura metal* (Nag, 1976). Role of steroids has been unequally established and the kinds and proportion of sterol very considerably from one plant species to another (Butcher 1977). Cholesterol, β - sitosterol, stigmasterol and campesterol have been reported from seeds of *Nicotiana tobacum* and *Datura stramonium* (Jeong et al. 1978). β - sitosterol, stigmasterol and campesterol were isolated from above ground part of *Fagonia glutinosa* (Al-Nagdy and Rizk 1978). Stigmasterol become dominant to β - sitosterol as fruit matures (Chow et al. 1978).

β - sitosterol, stigmasterol were isolated from roots, stems and seeds of *Tribulus alatus* (Nag et al. 1979) It is investigated that *Solanum* species are a source of steroidal sapogenins (Kardos and Baceubg 1980). β - sitosterol with lanosterol have been reported in seeds of *Peganum harmala* (Singh and Nag, 1981). Wurst (1982) suggested that concentration of free sterols and steryl esters is minimum at the time of irreversible drought injury. Phytosterols were isolated form the weed *Eichhornia crassipes* (Goswami et al. 1983; Della Green et al. 1991) and *Costus malortieanus* (Prasad and Ammal, 1983).

In many medicinal plants the predominant sterol was found to be β - sitosterol (Hooper and Chandler 1984). Srivastava et al. (1985) isolated phytosterols from presumed residue after methanogenic fermentation.

Jain and Agarwal (1988) while working with plant growth hormones on *Trigonella foenumgraecum* found that the diosgenin and trigogenin increased considerably with spray of 100 ppm of GA3. Mathur (1988) studied the sterols from various plant parts and tissue culture of *Zygophyllum simplex*. Singh (1989) and Kapoor (1991) reported stigmasterol and β -sitosterol from *Abutilon pannosum, Ocimum americanum* and *Fagonia cretica*. Apple squeezes contain sitosterol, cholesterol, campesterol and 24-ethylidenelophenol and can be recommended as a new source of phytosterols (Zambakhidze et al. 1990). Bis-labdonic-diterpenoids from *Alpinia calcarata* showed cytotoxic activities (Kong et al. 2002). Iridoids identified from *Valeriana jatamansi* rhizomes and roots (Tang et al. 2002). Ragasa et al. (2005) reported sterols from *Pongamia species*.

The biosynthesis of major phytosterols like campesterol, stigmasterol and sitosterol is inhibited by the application of fungicide. It also retarded the growth of the shoot, primary leaf and root of wheat and maize which may be due to the interaction of the
fungicide with the sterol enzyme system (Khalil and Mercer 1991). Shinde et al. (2008) reviewed production of phytoestrogens by plant cell and tissue culture.

Hirata et al. (1996) isolated free sterols from shoot primordial of Matricaria chamomilla. Begum and Siddique (1997) identified triterpenoids from Eucalyptus leaf. Savikin et al. (1998) observed the phytosterols contents in five callus lines of Dioscorea balcanica. Steroids were identified from whole plant of Euphorbia species (Tanaka et al. 2000) Steroidal saponins identified from Dracaena surculosa (Yokosuka et al. 2000) Bonfils et al. (2001) identified irridoids and triterpenoids from Iris showed cytotoxic and anti-tumor activities. Plant sterols have been shown to reduce dietary cholesterol absorption and hence, total and low density-lipoprotein (LDL)-cholesterol concentration in humans (Denke 1995). Berques et al. (1995) reported the effectiveness of β - Sitosterol in the treatment of benign prostaic hyperplasia.

A qualitative and quantitative estimation of steroids from different part of Saponaria vaccaria has been reported by Kumar and Khanna (1993). They isolated four sterols, viz., β - sitosterol, lanosterol and stigmasterol in root, stem, leaf, flower and callus tissue, where as diosgenin was reported in the seed and callus tissue of this plant. Effect of chemical mutagens on steroidal sapogenin in callus culture of Trigonella foenum-graecum was carried out by Agrawal and Jain (1994).

Gas chromatographic analysis determined the β - sitosterol, campesterol and stigmasterol components from the extraction of corn oil food (Kim et al. 1990). Akihisa et al. (1991) isolated 18 sterols from aerial parts of Kalanchoe pinnata. Henry et al. (1991) found that sterols are biosynthesized mainly in the leaves and also in other plant parts. Qualitative analysis of sterols by TLC and ultraviolet spectra was conducted (Franzot and Handan 1994). β - Sitosterol, Stigmasterol and Emodin were isolated from the flower of Lilium devidii and identified on the basis of chemical reaction, UV, MS, HNMR and CNMR spectral data (Feng et al. 1994).

Steroidal alkaloids are pharmaceutically important compounds which are used of the partial synthesis of cortisone and related compounds. Various workers have reviewed the work on biosynthesis and production of steroidal alkaloids in vivo (Schreiber, 1968; Haftmann, 1967, 1974; Kaul and Zutshi, 1973) and their pharmaceutical important (Varadi and Csapo, 1966). Heble et al. (1968) for the first time reported it from the seedling callus of S. xanthocarpum. Apple and Lucia (1967), Kaul and Zutshi (1973) and Khanna et al. (1976) have described presence of Solanodine in S. aviculare, S. elaegnifolium, S. khasianum, S. nigrum and S. melongena (Jain and Jain, 1978).

Presence of diosgenin in rhizome, root, stem and leaf of Cortus malorticanus has been reported (Prasad and Ammal 1983). Tomita et al. 1970 estimated diosgenin from Dioscorea root. Presence of β - sitosterol has been described in roots of Corchorus olitorium and C. capsularis (Manzoor-I-Khuda and Islam 1971). The use of sapogenins, diosgenin is very much emphasized as the raw material for production of steroidal hormones. Kaul and Stabe (1968) for the first time isolated diosgenin from Dioscorea suspension culture. Abroshnikova et al. (1971) and Abroshnikova and Panina (1972) have also reported steroidal saponins and diosgenin from tissue culture of D. deltoidea. Tissue of Y. aloefolia yielded six sapogenins (smilagenin,
sarasasapogenin, tigogenin, hecogenin and chlorogenin) when grown as static culture (Khanna and Purohit, 1981).

For the time immemorial the medicinal importance of plant is well known to human beings. Antimicrobials are defined as those secondary metabolites which are capable for inhibiting the growth of other microorganisms (Kurzybski et al. 1967; Cochran and Hahn, 1975). A number of workers have investigated the occurrence of antimicrobials active compounds from higher plants (Dhar et al. 1973; Atal et al. 1978; Dhawan et al. 1977, 1980; Aswal et al. 1984 a, b). The work on the antibacterial activity of medicinal plant have been reviewed by a number of workers both in vivo (Gould and Bowle, 1952; Dhar et al. 1968, 1973) and in vitro (Nickell, 1959, 1962; Mathes, 1963, 1997; Khanna and Staba. 1968; Khanna et al.1971; Misawa et al. 1974; Harsh and Nag 1984; Jit et al. 1985). These studies have been reviewed by Skinner (1955) and Nickell (1959) covering 174 plant species including 157 families for screening of higher plants for biological activity. A number of plant species have been known to possess antimicrobial activity such as alkaloids of Indigofera microcarpa (De Morafs et al. 1991). A new Crabazole alkaloid isolated from an alcoholic extract of the stem of Clausena anisata was found to be active against gram positive and gram negative bacteria (Chakarborty et al. 1995).