2. REVIEW OF LITERATURE

India has one of the richest ethno-botanical traditions in the world. There are about 400 tribes and ethnic groups in India. All are knowledgeable about the availability and utility of a wide diversity of flora and fauna. They fully rely on local medicinal plants and animals in the forest nearby and use a wide range of plants either singly or in combination with other plants and in some cases with animal and animal products. The integral aspects of plants and animals in their traditional healthcare systems cannot be ignored (Jain, 1991). Many plants have been proved as vital sources of tribal medicine and several diseases such as tuberculosis, rheumatic and joint pain, asthma, piles, night blindness, paralysis, diabetes and cancers are known to be cured with the help of plant drugs.

India has one of the oldest and most diverse cultural traditions called “folk traditions” associated with the use of medicinal herbs and it is still a living tradition in India. The history of herbal medicines is as old as human civilization. India has an over 3000 years old medicinal heritage based on herbs. The sacred Vedas and other ancient Indian treaties give many references of these medicinal plants. One of the remotest records in traditional herbal medicine is “Vrikshayurveda” compiled by Parasaria which form the basis of medicinal studies in ancient India. More detailed accounts are in “Atharvana veda” (800 BC). Later came the “Ayurveda” the practice of which was recorded in Sanskrit. The Vedic and post-vedic period roughly from 4500 BC to 5000 AD had celebrated Indian physicians and herbalists. Atruya, Mahabaratha, Nagarjuna, Sashrutha and the Hindu Hippocrates Charaka were the
legendary figures of the traditional Indian medicine. India offered large and marvellous museum of herbal medicine and the magic practices of the primitive healers. Two memorable treaties Chraksamhita and Sushurutasamhita appeared between 4000 AD to 500 AD said to be the “Golden Age” of traditional herbal Indian medicine (Sinha and Sinha, 2005).

**Antidiabetic activity**

Several medicinal plants have been used as dietary adjunct and in the treatment of numerous diseases without proper knowledge of their function. Although phytotherapy continuous to be used in several countries, few plants have received scientific or medical scrutiny. Moreover, a large number of medicinal plants possess some degree of toxicity. For example, it was reported that about one third of medicinal plants used in the treatment of diabetes are considered to be toxic (Marles and Fransworth, 1994). Numerous animal studies have shown that ethanolic extracts of leaves and flowers of *Catharanthus* lower blood glucose levels (Ghosh and Gupta, 1980).

Diabetes mellitus is a clinical syndrome characterized by inappropriate hyperglycemia caused by a relative or absolute deficiency of insulin or by a resistance to the action of insulin at the cellular level. It is the most common endocrine disorder, affecting 16 million individuals in the United States and as many as 200 million worldwide.

Diabetic mellitus (DM) is the condition arising due to abnormal metabolism of carbohydrate, proteins and fats. It is caused by insulin deficiency, often combined with insulin resistance. This disorder occur world wide and its occurrence is
increasing quickly in most of the countries. Various complications develop as a consequence of the metabolic derangement in diabetes 2. The treatment of DM is based on parental insulin and oral antidiabetic drugs. Oral hypoglycemic agents, currently used have serious side effect hence there is a need to search newer anti-diabetic agents that having high therapeutic efficacy with minimum side effects. This may be fulfilled by treating DM with traditional medicine using as antidiabetic agents from medicinal plants.

Diabetes mellitus has been known since ages and the sweetness of diabetic urine has been mentioned in Ayurveda by Sushruta. Its pharmacotherapy however is over 80 years old. Diabetes is a chronic disease affecting around 2-3% of the population worldwide. Unfortunately, after the introduction of sulfonylurea and metformin about 50 years back no major lead has been obtained in this direction of finding a proper drug for diabetes. Plant materials which are being used as traditional medicine for the treatment of diabetes are considered one of the good sources for a new drug or a lead to make a new drug. Plant extract or different folk plant preparations are being prescribed by the traditional practitioners and also accepted by the users for diabetes like for any other disease in many countries especially in third world countries. Now-a-days more than 400 plants are being used in different forms for hypoglycemic effects all the claims practitioners or users are neither baseless nor absolutely. Therefore, a proper scientific evaluation a screening of plant by pharmacological tests followed by chemical investigations is necessary.

Diabetes is a disorder of metabolism, the way our bodies use digested food for growth and energy. Most of the food we eat is broken down into glucose, the form of
sugar in the blood. Glucose is the main source of fuel for the body. After digestion, glucose passes into the bloodstream, where it is used by the cells for growth and energy. For glucose to get into cells, insulin must be present. Insulin is a hormone produced by the pancreas, a large gland behind the stomach. When we eat, the pancreas automatically produces the right amount of insulin to move glucose from blood into our cells. In people with diabetes, however, the pancreas either produces little or no insulin, or the cells do not respond appropriately to the insulin that is produced. Glucose builds up in the blood, overflows into the urine, and passes out of the body in the urine. Thus, the body loses its main source of fuel even though the blood contains large amounts of glucose.

The first stage in type 2 diabetes is the condition called insulin resistance; although insulin can attach normally to receptors on liver and muscle cells, certain mechanisms prevent insulin from moving glucose (blood sugar) into these cells where it can be used. Most type 2 diabetics produce variable, even normal or high amounts of insulin, and in the beginning this amount is usually sufficient to overcome such resistance. Over time, the pancreas becomes unable to produce enough insulin to overcome resistance. In type 2 diabetes the initial effect of this stage is usually an abnormal rise in blood sugar right after a meal (called postprandial hyperglycemia). This effect is now believed to be particularly damaging to the body. Eventually, the cycle of elevated glucose further impairs and possibly destroys beta cells, thereby stopping insulin production completely and causing full-down diabetes. This is made evident by fasting hyperglycemia, in which elevated glucose levels are present most of the time.
Once daily administration of the juice of *Lantana camara* L. leaves are given at different dose levels for 14 days in rats resulted in alterations in various haematological and biochemical parameters. A strong hypoglycemic effect was seen with 1500 mg only (Garg et al., 1997).

The ethanolic extract of *Thespesia populnea* bark and leaf was investigated for hypoglycemic effect in streptozotocin induced diabetic rats and to compare this effect with glibenclamide, a standard hypoglycemic agent and also measure the lipid peroxide, superoxide dismutase and catalase enzyme level in the kidney of the animal.

Several plant species have been described as hypoglycemic. These include *Opuntia streptacantha*, *Trigonella foenum-graecum*, *Memordica charantia*, *Ficus benghalensis*, *Polygala senega*, *Gymnema sylvestre*, *Allium sativum*, *Citrullus colocynthis*, myrrh, black seeds, helteet, fenugreek, *Aloe* and *Artemisia* (Atta-Ur-Rahman and Zaman, 1989; Bnouham et al., 2002 and Ziyyat et al., 1997).

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Oral administration of the extract of *Astracantha longifolia* can significantly improve glucose tolerance in healthy human subjects and diabetic patients (Fernando et al., 1991). *Achyranthes aspera* L. extract produced a significant dose-related hypoglycemic effect in normoglycemic and Alloxan induced diabetic rabbits. In these
animals, water and methanol extracts also decreased blood sugar levels. The plant may act by providing certain necessary elements like calcium, zinc, magnesium, manganese and copper to the beta-cells (Akhtar and Iqbal, 1991).

The antihyperglycemic effect of *Cuminum cyminum* L. was studied in healthy rabbits subjected to weekly subcutaneous glucose tolerance tests after gastric administration of water, tolbutamide or a traditional preparation of the plant. The results showed that the *C. cyminum* significantly decreased the area under glucose tolerance curve and the hyperglycemic peak (Roman - Ramos *et al*., 1995).

Saponin isolated from the leaves of *Acanthopanax senticosus* injected to mice decreased experimental hyperglycemia induced by injection of adrenalin, glucose and Alloxan, without affecting the levels of blood sugar in untreated mice (Sui *et al*., 1994). *Gymnema sylvestre* was administered to the conventional oral drugs. During GS4 supplementation, the patients showed a significant reduction in blood glucose, glycosylated haemoglobin and glycosylated plasma proteins, and conventional drug dosage could be decreased.

Administration of extracts obtained from *Beta vulgaris var. cicla* L. (leaf beet); (sugar beet) inhibited the increase in the nonenzymatic glycosylation of skin proteins and blood glucose. These results demonstrated the ability of this plant in preventing or at least retarding the development of some diabetic complications (Tunali *et al*., 1998). The aqueous fraction of a methanolic extract of *Dioscorea dumetorum* Linn. has a hypoglycemic effect in healthy and Alloxan diabetic rabbits when administered i.p. a decrease in Blood glucose level (BGL) was observed 3hour after oral administration of a 50% methanolic extract of *Phyllanthus urinaria* L. in
streptozotocin induced diabetic rats. The n-butanol soluble fraction extract was most effective.

S-allyl cysteine sulphoxide (SACS), a sulphur-containing amino acid of *Allium sativum* L. (garlic) that is the precursor of allicin and garlic oil, has been found to show significant antidiabetic effects in Alloxan diabetic rats. Administration of a dose of 200 mg/kg significantly decreased the concentration of serum lipids, blood glucose and activities of serum enzymes like alkaline phosphatase, acid phosphatase and lactate dehydrogenase and liver glucose 6 phosphatase. It significantly increased liver and intestinal HMG CoA reductase activity and liver hexokinase activity (Sheela and Augusti, 1992).

*Sida cordifolia* extracts of the aerial and root parts showed hypoglycemic activity. Moreover, the methanol extract of root was found to possess significant hypoglycemic activity. *Azadirachta indica* leaf extract significantly blocked the inhibitory effect of serotonin on insulin secretion mediated by glucose (Chattapadhyay, 1999). Furthermore, *A. indica* leaf extract was found to have the most potent blood sugar lowering followed by *Catharanthus roseus*, *Gymnema sylvestre* and *Ocimum sanctum* (Chattapadhyay, 1993). *Tinospora crispa* is probably due to stimulation of insulin release via modulation of intracellular Ca$^{2+}$ concentration in pancreatic beta-cells (Noor and Asherof, 1998). Oral administration of an aqueous extract of *Tinospora cordifolia* roots produced a significant decrease in glycemia and brain lipids in Alloxan-induced diabetic rats (Stanley *et al*., 1999).

The effect of a decoction of leaves of *Ficus carica* L. as a supplement to breakfast was studied in insulin-dependent diabetes mellitus (IDDM) patients. A
methanol extract of *Nelumbo nucifera* Gaertn. (East Indian Lotus) extract caused a decrease in glycemia in streptozotocin-induced diabetic rats by 53% and 55% respectively at the end of 12 h (Mukherjee *et al*., 1995).

Oral administration of the aqueous-ethanolic (50%, v/v) extract of the flowers of *Punica granatum* L. (Guhar farsi) produced a significant decrease in glycemia in glucose-fed hyperglycemic and Alloxan induced diabetic rats.

The leaf extract of *Aegle marmelos* (L.) Corea ex Roxb. was found to be as effective as insulin in the restoration of blood glucose and body weight to normal levels. *A. marmelos* can be used as potential hypoglycemic agent (Benjamin *et al*., 1994).

**Antihyperlipidaemic activity**

From the seventeen major causes of human death, cardiovascular diseases rank seventh. Coronary heart disease (CHD) is the cause of mortality in 50% of people around the world (Faergeman, 2000 and Sullivan, 2002). Hyperlipidaemia is considered to be the most influencial risk factor for CHD (Torres *et al*., 2000; Nilson *et al*., 2001 and Patel, 2001). Therefore, maintaining low blood lipid profile and blood cholesterol is essential for cardiovascular health. A 20% reduction of blood cholesterol level can decrease about 31% of CHD incidence, and 33% of its mortality rate (Scott, 1997).

Hyperlipidaemia is a well-known risk factor for several illness including atherosclerosis, heart and vascular diseases and stroke. The pulp and the seeds of *Citrullus colocynthis* were assessed for their effects on the lipid profiles of
hyperlipidaemic New Zealand rabbits (Zamania et al., 2007). Thounaojam et al. (2009) evaluated the efficacy of freeze dried extract of *Sida rhomboidea* leaves on alteration in lipid and cholesterol metabolism in high fat diet induced hyperlipidaemia in experimental rats. Plasma and lipid profiles, lipid and cholesterol metabolizing enzymes in target tissues and fecal total lipids and bile acid contents were evaluated in freeze dried extract of *Sida rhomboidea* treated normolipidaemic and hyperlipidaemic rats. The effects of repeated administration of aqueous extract of *Fadogia agerestis* stem on serum lipid profile of male rats and their recovery tendencies for 10 days post administration were investigated (Toyin et al., 2008). Keshetty et al. (2009) have reported the effect of garlic extract on lipid profiles in Triton X-100 induced hyperlipidaemia in male Wistar rats. The garlic extracts significantly increased (p < 0.001) plasma HDL-Cholesterol and decreased plasma TC, LDL-cholesterol and TG levels as compared with hyperlipidaemic control. Thiruvenkatasubramanian and Jayakar (2010) have reported the effect of ethanol extract of *Premna corymbosa* on lipid profiles in streptozotocin induced diabetic rats. There was significant reduction in total cholesterol, LDL cholesterol, VLDL cholesterol and important in HDL cholesterol in diabetic rats.

The antihyperlipidaemic efficacy of ethanol extract of *Gymnema montanum* leaves was investigated in Alloxan- induced diabetic rats and the effect was compared to standard hypoglycemic drug, glibenclamide (Ramkumar et al., 2008). The root and leaf of *Calotropis procera* were investigated for their antihyperlipidaemic effect in male Wistar albino rats (Bhaskar and Ajay, 2009). Sangameswaran et al. (2008) have reported the lipid lowering properties of the aqueous extract of roots of *Thespesia lamps* on experimentally Triton X-100 induced rats. Sangameswaran and Ilango
(2010) reported the antihyperglycemic and antihyperlipidaemic effects of methanol and aqueous extracts of *Andrographis lineata* in normal and streptozotocin induced diabetic rats. Lipid lowering effect of 50% ethanolic extract of the leaves of *Aegle marmelos* was evaluated in Triton X 100 and diet induced hyperlipidaemic models of Wistar albino rats (Vijaya *et al.*, 2009).

**Hepatoprotective activity**

Liver diseases are one of the most severe ailments. They are mainly caused by toxic chemicals, excess consumption of alcohol, infections and autoimmune disorders. Most of the hepatotoxic chemicals damage liver cells mainly by inducing lipid peroxidation and other oxidative damage in the liver. They may be classified as acute or chronic hepatitis (inflammatory liver diseases), hepatosis (non-inflammatory diseases) and cirrhosis (degenerative disorder resulting in fibrosis of the liver).

Inspite of tremendous advances made in allopathic medicine, management of liver diseases is still a challenge to modern medicine. The modern medicine offer little for the alleviation of hepatic ailments, whereas the most important resrepresentives are the phytoconstituents (Chandrasekhar *et al.*, 2004). Plant drugs are known to play a vital role in the management of liver diseases. About 80% of the world’s population relies on the use of traditional medicines which are predominantly based on plant materials (Satagopan, 2000). Numerous plants and polyherbal formulations are reported to possess hepatoprotective activites (Malhotra *et al.*, 2001). In order to develop satisfactory herbal combination to treat liver diseases, plants have antioxidant, stimulation of liver regeneration and cholorectic properties (Subramaniam and Pushpangadan, 1999).
Ayurvedic and other traditional medical practitioners of the world have claimed for centuries that, extracts from plants can be effectively used for the alleviation of different types of liver diseases (Subramaniam and Pushpangadan, 1999). Most of the claims, however, are anecdotal and very few have received adequate medical or scientific evaluation. Except for the use of appropriate vaccine for the treatment of hepatitis caused by viral infection, very few effective treatments are available today to cure liver diseases. It is not surprising, therefore that a considerable interest has been taken by researchers to examine there numerous traditional plant remedies, used for treating liver disorders. In recent years, investigations have been carried out to provide experimental evidence confirming that many of these plants do have hepatoprotective properties (Sharma et al., 2003).

Aqueous extract from seeds of *Areca catechu* and nutgalls of *Quercus infectoria* were investigated for their hepatoprotective potential against liver injury induced by carbon tetrachloride (CCl4) in rats (Pithayanukul et al., 2009). Mondal et al. (2005) reported that methanol extract of *Diospyros malabarica* bark has potent hepatoprotective activity against carbon tetrachloride induced liver damage in rats. Dash et al. (2007) reported that chloroform and methanol extracts of entire plant of *Ichnocarpus frutescens* is an effective hepatoprotective agent by paracetamol induced liver damage in rats. Shyamal et al. (2010) reported that ethanol extracts of roots of *Ixora coccinea, Rhinacanthus nastus* and whole plants of *Spilanthes ciliata* have potent hepatoprotective activity against aflatoxin B1 intoxicated livers of albino male Wistar rats. The hepatoprotective activity of ethanolic and aqueous extracts of *Amorphophallus campanulatus* tubers were evaluated against carbon tetrachloride
induced hepatic damage in rats. The ethanolic extract was found hepatoprotective more than the aqueous extract (Jain et al., 2009). The volatile oil, ethyl acetate, n-butanol and total alcoholic extracts of *Juncus subulatus* were evaluated for their hepatoprotective and antioxidant activity in female rats against ethanol-induced hepatic injury. The results showed that all extracts of *Juncus subulatus* exhibited hepatoprotective activity (Abdul-Razik et al., 2009). Iniaghe et al. (2008) reported that the aqueous extract of leaves of *Acalypha racemosa* has effective hepatoprotective against CCl$_4$ induced liver damage. The flower heads of *Sphaeranthus indicus*, a traditional Indian medicinal plant is commonly used to nourish and improve the liver conditions. Tiwari and Khosa (2009) evaluated the hepatoprotective and antioxidant effect of aqueous and methanolic extract of flower heads of *Sphaeranthus indicus* on acetaminophen induced hepatotoxicity in rats *in-vivo*. Hepatoprotective activity of hydro alcoholic extract of *Luffa acutangula* against carbon tetrachloride and rifampicin-induced hepatotoxicity in rats was evaluated and probable mechanism(s) of action has been suggested (Jadhav et al., 2010).

**Antifertility activity**

The options available to men for fertility control are much more limited compared to those for women. The male reproductive system, particularly the process of spermatogenesis, sperm maturation and transport and also the sperm-egg interaction are so complex that it has not so far been possible to find an effective intervention that can be converted into a product. Continued efforts over the past three decades to develop additional methods of male contraception have made some significant contribution in the field. However, there is still no method available in the field of male contraception that satisfies the essential criteria of safety, efficacy,
economy and complete reversibility. Inspite of considerable development in contraceptive technology, search for male antifertility agents in plants continues to be a potential area of investigation.

Recently, efforts are being made to explore the hidden wealth of medicinal plants for contraceptive use. With the exciting prospects of gene therapy, herbal medicine remains one of the common forms of therapy available to much of world’s population, to maintain health and to treat diseases.

There has been a steady accumulation of information regarding the screening of plants having antifertility efficacy (Hanshaw, 1953; Chopra et al., 1956; Chopra et al., 1958; Casey, 1960; Bhakuni et al., 1969 and Farnsworth et al., 1975 a and b). The folklore information and the ancient literature about the plants and herbs can help the antifertility program. In the recent past, a number of plants have been identified and evaluation of extracts and active principles from different parts of plants like seeds, roots, leaves, flowers, stem or stem barks have been done by various researchers. These reports have been exhaustively reviewed (Orzechowski, 1972; Brondegaard, 1973; Kholkute et al., 1976; Kamboj and Dhawan, 1982; Zhu, 1982 and Satyawati, 1983). A literature survey for the period of 25 years (1980-2005) revealed that there are about 105 plants which possess antifertility activity in males (Gupta and Sharma, 2006).

Antifertility effect of ethanolic leaf extracts of *Alstonia scholaris*, *Cleistanthus collinus* and *Terminalia bellirica* and root extract of *Murraya paniculata* were observed in male albino rats (Choudhary et al., 1991). Gossypol, a yellow phenolic compound isolated from cotton seed oil was proposed as a male contraceptive drug.
Hadley et al. (1981) found that gossypol treatment reduced the level of serum testosterone and luteinizing hormone levels in a dose and duration dependent manner. Gossypol acts directly on testes and induces azoospermia or oligospermia (Xue, 1980 & 1985 and Taitzoglou et al., 1999). A multiglycoside extracted from the root xylem of Tripterygium wilfordii was shown to have a reversible antifertility action in male rats in a Task-Force supported study (Qian, 1987). Its antifertility activity is well documented in rats, mice and humans (Qian, 1986; Zheng et al., 1986 and Qian et al., 1995).

Administration of chloroform extract of Carica papaya seeds showed suppression of cauda epididymal sperm motility and counts in rats and suggested that contraceptive effects are mainly post testicular in nature without influencing toxicological profile and lipids of animals (Lohiya and Goyal, 1992). Verma and Chinoy (2001) reported that the Carica papaya seed extract alters cauda epididymal micro environment. Manivannan et al. (2004) observed ultrastructural changes in the testis and epididymis of rats following treatment with the benzene chromatographic fraction of the chloroform extracts of the Carica papaya seeds. Dehghan et al. (2006) reported that the Azadirachta indica seed extract alters vas deferens and epididymal milieu and affects the spermatozoa. It is evident that extract has potential as an antifertility agent.

**Antiinflammatory activity**

The term “rheumatism” embraces a variety of disorders that have in common pain and stiffness referable to the musculoskeletal system. When such symptoms are due to abnormality of the joint itself, the condition can be classified as arthritis. Non
articular rheumatism includes those conditions in which the symptoms are produced not by pathologic changes in the joints proper, but in the structures contiguous to, or related to the joints. Although arthritis occurs in a number of different forms, there are essentially two fundamental pathological processes that affect the joints viz., inflammation, which may be exudative or proliferative or a combination of each and degenerative changes, which are primarily dependent on the limited capacity of articular cartilage to repair itself (Loeb, 1971).

The target should be to discover new drugs from plant kingdom which may provide therapeutic cure and would be free from undesirable effect as well as economical, which would be accepted by the developing nations like India (Huang, 1999).

A systematic study of antiinflammatory effects of Indian medicinal plants began by Gujral and his associates. They screened a number of plants for their antiarthritic effects. Subsequently, various workers from different laboratories in India have made significant contributions. In the sixties, formaldehyde induced arthritis and croton oil induced granuloma pouch in rats were mainly used as the experimental models of inflammation. Later, with the introduction of better and more specific models of experimental inflammation like carrageenan induced paw oedema in rats, cotton pellet induced granuloma in rats, Freud’s complete adjuvant induced arthritis etc., workers in different laboratories tested their drugs with the help of the later models. Scientist in Central drugs Research Institute, Lucknow have studied nearly two thousand Indian medicinal plants for their various pharmacological properties (Chatterjee and Pal, 1984 and Shah et al., 2006). The greatest disadvantage in the
presently available potent synthetic antiinflammatory drugs lies in their toxicity and reappearance of symptoms after discontinuation. Therefore, the search for their antiinflammatory activity (AIA) is an unending problem (Chawla et al., 1987 and Shen, 1981).

The petroleum ether extract of the rhizomes of *Curcuma longa* (turmeric) showed significant antiinflammatory activity (AIA) and was effective in delayed hypersensitivitity. Curcumin, a constituent of turmeric, chemically, known as diferuloyl methane has been shown to be effective (Srimtal and Dhawan, 1973). It is as potent as phenylbutazone in the carrageenan induced oedema test but half as potent in chronic tests. In subacute inflammation models in rats, it is found to be a stabilizer of lysosomal membrane (more potent than Ibuprofen) and as an uncoupler of oxidative phosphorylation (Srivastava and Srimtal, 1985). Two naturally occurring curcumin-related analogues, feruloyl - 4 - hydroxycinnamoyl methane and bis (4-hydroxy cinnamoyl) methane, have shown AIA. Water soluble sodium curcuminate showed better AIA than curcumin in albino rats. Epicatechin, isolated from seed coat of *Anacardium occidentale* appears to be atleast as effective as phenylbutazone against various test models (Swarnalakshmi et al., 1981). Bergenin, isolated from the pods of *Peltophorum pterocarpum* was found to be equipment to phenylbutazone in rats against carrageenan induced oedema (Menon et al., 1982).

The flavanoid glycoside, chrysoeriol 7-O-β-D glucopyranosyl-D-apiofuranoside isolated from *Dalbergia volabilis* exhibited AIA (Hye and Gafur, 1975). A flavonoid from *Hedychium spicatum* showed a significant activity with less ulcerogenic index than phenylbutazone (Srimtal et al., 1984). Flavonone glycosides,
diinsininol and diinsinin from rhizomes of *Sacrophyte piriei* (Balanophoraceae), showed prostaglandin synthesis inhibition and the inhibition of platelet-activating-factor-induced exocytosis, respectively.

The compound - Dicadalenol, Caryolane-1, 9β-diol and quercetin were the most active substances tested and displayed dose dependent activities, isolated from aerial parts of *Heterotheca inuloide* (Asteraceae) (Delgado *et al*., 2001). Quercetin, quercetin 3-0-rhamnoside (quercitrin) and quercitrin 3-0-rutinoside (rutin) from 80% MeOH extract of leaves of *Morinda morindoides* (Rubiaceae) showed similar inhibition of classical pathway of complement system (Kayanga Cimanaga *et al*., 1995). The dichloromethane extract of the aerial parts of *Tanacetum microphyllum* (Compositae) yielded two antiinflammatory flavonoids: 5,7,3′-trihydroxy-3,6,4′-trimethoxy flavones (centaureidin) and 5,3′-dihydroxy-4′-methoxy-7-carbomethoxyflavonol (Abad *et al*., 1993). Three flavonoids, isolated from *Inula viscosa* (Asteraceae) dichloromethane extract were 7-0-methylaromadendin, rhamnocitrin and 3-0-acetylpadmatin along with a sesquiterpene lactone inuvisolide; a sesquiterpene acid, ilicic acid; and a diagalactosyl-diacylglycerol, inugalolipid A and shown to have 12-0-tetradecanoylphorbol-13-acetate induced ear edema inhibitory activity in mice (Manez *et al*., 1999).

Calophylolide from the nuts of *Calophyllum* species (Clusiaceae) effectively reduced the increased permeability induced by the chemical mediators involved in inflammation like histamine, serotonin and bradykinin. Magniferin, a xanthone C-glucoside from *Canscora decussatata*, mangostin and related compounds from *Garcinia mangostana* (Shankaranarayan *et al*., 1979) and xanthones from
*Calophyllum inophyllum* and *Mesua ferrea* are shown to have antiinflammatory activity (Gopalakrishnan *et al*., 1980).

The triterpenoids of the oleanene and ursene series were found to be active against carrageenan induced oedema, formaldehyde induced oedema and formaldehyde - induced arthritis in rats. It has been suggested that, the antiinflammatory activity of the triterpenoids of the oleanene series with the polarity of compounds which is enhanced by the number of hydroxyl groups in the molecule (Bhargava *et al*., 1970). Salai guggal, the oleogum of *Boswellia serrata*, has been shown to possess antiinflammatory and antiarthritic activities. It was shown to be effective in controlled clinical trials in arthritic patients. It’s activity may be due to the boswellic acids present in the oleogum (Atal *et al*., 1980). Two new triterpene saponins having phospholipase D inhibitory activity were isolated from extract of the leaves of *Myrsine australis*. Oleanolic acid 3- β-glucoside isolated from the seeds of *Randia dumetron* showed a significant AIA in the exudative and proliferative phases of inflammation in rats (Ghosh *et al*., 1983).

The oleoresin fraction of *Commiphora mukul* possesses significant antiarthritic and antiinflammatory activities. A steroidal compound isolated from *C. mukul* displayed a significant activity which is dose dependent and more potent than the resin fraction present in *C. mukul*. A comparison of the antiinflammatory activity of petroleum ether extractive of *C. mukul* with standard drugs showed the former to be effective as well. The ethyl acetate-soluble portion of the resin (guggalipid) on fractionation revealed that the acids display a significant antiinflammatory activity while the neutral portion carries partially all hypocholesterolemic activity. It was
soon found that neutral fraction contained several ketones, which exhibited a high lipid lowering activity. Further work led to the isolation of these compounds and it was found that two steroids, named Z- and E- guggalsterone are responsible for the activity of the resin. The former has shown in rats to have a thyroid - stimulating action, suggesting that this property may be contributing to antihyperlipidaemic activity of the oleoresin (Satyavati et al., 1969). β-sitosterol isolated from Cyperus rotundus possessed potent antiinflammatory activity against carrageenan and cotton pellet-induced oedema in rats and was comparable to hydrocortisone and oxyphenbutazone (Singh et al., 1970). The compound also possesses significant antipyretic activity (Gupta et al., 1971). A- spinasterol obtained from the stem-bark of Symplocos spicata showed a significant activity against acute inflammation induced by carrageenan in rats.

Tylophorine, an alkaloid isolated from Tylophora indica, apart from the anaphylactic and immunocytadherence action significantly inhibited the primary and secondary responses of adjuvant-induced arthritis in rats (Gopalakrishnan et al., 1979). A glucosidic substance from leaves of Dalbergia volubilis (Papilionaceae) showed antiinflammatory and antiarthritic activities (Hye and Gafur, 1975). Alcoholic extract of Cardiospermum helicacabum (Sapindaceae) leaves showed significant antiinflammatory activity in rats.

Cedrus deodora, stem bark showed significant AIA in rat (Gopala et al., 1976). Gangetin, one of the pterocarpens, isolated from hexane extract of root of Desmodium gangeticum also produced a significant AIA in the exudative and proliferative phases of inflammation in rats (Ghosh and Kumar, 1983). Radiological
findings evidently supported the long term antiarthritic property of *Withania somnifera* (Solanaceae) (Hazeena Begum and Sadique, 1988).

Handa et al. (1992) cited that species of 96 genera belonging to 56 families are ascribed antiinflammatory activity. The triterpenes alpha-amyrin acetate, beta-amyrin acetate and lupeol acetate of *Alstonia boonei* were evaluated for antiarthritic activities in rats (Kweifio-Okai and Carroll, 1992 and 1993). The antiinflammatory activity of the aqueous extract of the stem bark of *Bridelia ferruginea* was evaluated using carrageenan induced paw oedema in rats and mice (Olajide et al., 1999).

The antiinflammatory activity of the aqueous extracts of roots of *Rumex patientia* was evaluated using carrageenan, histamine, dextrane, serotonin and formaldehyde- induced oedema tests (Suleyman et al., 1999). The alcoholic extract of *Clerodendron serratum* roots was evaluated for their antiinflammatory activity in animal models (Narayanan et al., 1999).

The lyophilized aqueous extract of the fruits of the *Opuntia dillenii* was demonstrated for analgesic and antiinflammatory properties in rats and mice (Loro et al., 1999). Aqueous and alcoholic extracts of pods and flowers of *Tecoma sambucifolia* were analysed to determine their antiinflammatory activity using carrageenan-induced oedema test (Alguacil et al., 2000). Fangchinoline and tetrandrine, major alkaloids from *Stephania tetrandrae* have been used traditionally to treat inflammatory diseases in Korea. Both fangchinoline and tetrandrine showed antiinflammatory effects on the mouse (Choi et al., 2000).
Hexane, chloroform and methanol extracts of seven herbal drugs (Aristolochia trilobata - leaves and bark, Bursera simaruba - bark, Hamelia patens -leaves, Piper amalago - leaves and Syngonium podophyllum - leaves and bark) were evaluated for their typical antiinflammatory activity (Sosa et al., 2002). The ethanol extracts of the rhizomes of Cistanche deserticola has been evaluated for their antiinflammatory activity (Lin et al., 2002).

Satureja hortensis is a medicinal plant used in Iranian folk medicine as muscle and bone pain reliever. In the hydro alcoholic extract, polyphenolic fraction and essential oil of the aerial parts of the herb were prepared and evaluated for their antiinflammatory activity using carrageenan induced paw oedema in rats (Hajhashemi et al., 2002).

Methanol extract of dried leaves of Alstonia macrophylla and its fractions were investigated for its antiinflammatory activity in carrageenan-induced rat paw oedema (Arunachalam et al., 2002). Antiinflammatory activity of an ethanolic extract from Bouchea fluminensis leaves has been demonstrated (Delaporte et al., 2002).

The crude ethanol extract and the chloroformic and aqueous fractions of Sideritis canariensis var. pannosa have been examined for their antiinflammatory and analgesic effects in several animal models (Hernandez-Perez and Rabanal, 2002).

Aqueous, hexane and methanol extracts of 12 plant species, traditionally used in Kenya were evaluated for their antiinflammatory activity (Matu and Staden, 2003). The antiinflammatory activity of the alcoholic extract of stems of Tabernaemontana
*Pandacaqui* was evolved using carrageenan induced rat paw oedema (Taesotikul *et al.*, 2003).

*Mitragyna ciliata* is widely used in traditional medicine to treat inflammation, hypertension, headache, rheumatism, gonorrhoea and broncho-pulmonary diseases. The antiinflammatory and analgesic properties of the hexane and methanolic extracts of the stem bark of *M. ciliata* have been investigated (Dongno *et al.*, 2003).

Antiinflammatory activities of ethanol extracts from 9 vine plants used in traditional Chinese medicine to treat inflammatory conditions were evaluated (Li *et al.*, 2003). The methanol-water extract of *Barleria prionitis* was evaluated for antiinflammatory and antiarthritic activities against different acute and chronic animal test models (Singh *et al.*, 2003).

The leaves of the *Acanthus ebracteatus*, stem bark of *Oroxylum indicum* and the stems of *Cryptolepis buchanani* and *Derris scandens* are used as traditional remedies in Thailand for arthritis. Aqueous and alcoholic extracts were tested using three different *in vitro* systems for effects relevant to antiinflammatory activity (Laupattarakasem *et al.*, 2003).

Pharmacological studies were conducted on the hexane extract of the dry stem of *Diospyros variegata* on experimental animals for evaluating its analgesic, antipyretic and antiinflammatory activities (Trongsakul *et al.*, 2003). The methanolic extract from *Clerodendrum petasites* was assessed for antiinflammatory and antipyretic activities on experimental animals. It was found that, the extract possessed moderate inhibitory activity on acute phase of inflammation (Panthong *et al.*, 2003).
The petroleum ether, chloroform, methanol and aqueous extracts of *Sesbania sesban* leaves were investigated for antiinflammatory activity in albino rats (Tatiya *et al.*, 2007). The petroleum ether, ethyl acetate, ethanol and aqueous extracts of *Calotropis gigantea* leaves were screened for antiarthritic activities in albino rats (Patil *et al.*, 2007). The aqueous extract of *Eucalyptus globulus* leaves was investigated for its antiinflammatory activity in carrageenan - induced paw oedema and cotton pellet granuloma technique in albino rats (Deb *et al.*, 2007).