Chapter: 2

Literature Review

2.0 LITERATURE REVIEW

2.1 Acacia species:
Acacia is the most significant genus of family Leguminosae, first of all described by Linnaeus in 1773. It is estimated that there are roughly 1380 species of Acacia worldwide, about two-third of them native to Australia and rest of spread around tropical and subtropical regions of the world (Seigler, 2003). Acacia species are commonly known as ‘Babool’ in India and ethnomedicinally used for the treatment of various diseases. The large number of exudate gums obtained from trees of acacia and certain other families are hetero-polysaccharides and contain similarly bound sugars (D-galactose, L-arabinose and Deoxy-sugar) and uronic acid salts of Na, K, Ca and Mg.

2.1.1 Acacia, Babul (Acacia nilotica L. Willd. Ex Delile)
Acacia nilotica belonging to the family Leguminosae and sub family Mimosaceae is a moderate sized tree that grows up to 20m, but this is attenuated by site. It has a flattish or umbrella shaped crown and is easily identified by its bright yellow, sweet-scented flower heads, its sweet-smelling gray pods and its paired whitish spines at the base of each leaf. During the hot season the tree is in full leaf and its feathery foliage provides good shade. It is found throughout the drier parts of India (Bennison and Paterson, 1994).

Pods: The pods are 7-15 cm long, green and tomentose (when immature) or greenish black (when mature), indehiscent, deeply constricted between the seed giving a necklace appearance.

Seeds: The seeds are 8-12 per pod, compressed, ovoid, dark brown shining with hard testa (Iman et al., 2007).

Leaves: The leaves are bipinnate, pinnate 3-10 pairs, 1.3- 3.8 cm long, leaflets 10-20 pairs, and 2-5mm long (Beniwal et al., 1992).

Stem: Stems are usually dark to black coloured, deep longitudinal fissured, grey-pinkish slash, exuding a reddish low quality gum (Brenan, 1983).
Chapter 2: Literature Review

**Flowers:** Flowers are globular heads, 1.2-1.5 cm in diameter of a bright golden yellow colour, develop either in axillary or whorly pattern on peduncles 2-3 cm long located at the end of branches (Bargal and Bargali, 2009).

**Bark:** The bark a tinge of orange and/or green (young tree), but older trees have dark, rough bark and tend to lose their thorns (Khan et al., 2009).

**Thorns:** Thorns are thin, straight, light grey exist in axillary pairs (usually 3-12), 5-7.5 cm long in young trees.

**Roots:** Root is generally of brown colour in older and whitish in younger regions.

**Gum:** The gum varies in colour from very pale yellowish brown to dark reddish brown depending on the quantity of tannins in the sample. The lighter, more highly valued gums are soluble in water and very viscous; the tannins in the darker gum reduce the solubility. The gum has a moisture content of about 13% and is slightly dextrorotary (New, 1984).

**Chemical constituents:** It contains a high percentage of phenolic constituents consisting of m-digallic acid, gallic acid, its methyl and ethyl esters, protocatechuic and ellagic acids, leucocyanidin, m-digallic dimer 3,4,5,7-tetrahydroxy flavan-3-ol, oligomer 3,4,7-trihydroxy flavan 3,4-diol and 3,4,5,7-tetrahydroxy flavan-3-ol and (-) epicatechol. Fruit also contains mucilage and saponins. Also is rich in phenolics consisting of condensed tannins and phlobetannin, gallic acid, protocatechuic acid pyrocatechol, (+) – catechin, (-) epigallocatechin-5,7-digallate, apigenin, 6-8-bis-D-glucoside, and rutin (Seigler, 2003).

<table>
<thead>
<tr>
<th>Table 2.1: Taxonomic classification of A. nilotica</th>
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<tbody>
<tr>
<td>Kingdom</td>
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<tr>
<td>Sub-kingdom</td>
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<tr>
<td>Super division</td>
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<td>Division</td>
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<td>Family</td>
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<td>Genus</td>
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<td>Species</td>
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Photograph 2.1: Photograph of various parts of *A. nilotica*
2.2 Research updates on *A. nilotica*:

According to traditional medicine and indigenous knowledge, fruit was given to combat diarrhoea, haemorrhage, as a sedative in labour, as a cure for sore gums and loose teeth. The leaves were chewed to stop nausea. Traditionally used for colds, congestion, coughs, dysentery, fever, gallbladders, hemorrhages, leucorrhea, ophthalmia, sclerosis, smallpox and tuberculosis (Saini, 2008).

**Table 2.2: Reported biological activities of *A. nilotica***

<table>
<thead>
<tr>
<th>Biological activity</th>
<th><em>A. nilotica</em></th>
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<tr>
<td>Antimutagenic and Cytotoxic effects</td>
<td>Kaur et al., 2005</td>
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<tr>
<td>Antibacterial activity</td>
<td>Raghavendra et al., 2006</td>
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<tr>
<td>Antimicrobial activity</td>
<td>Banso, 2009</td>
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<td>Antioxidant activity</td>
<td>Singh et al., 2008, 2009</td>
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<td>Singh et al., 2009</td>
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<td>Sultana et al., 2007</td>
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<tr>
<td>Lactating activity</td>
<td>Ouedraogo et al., 2004</td>
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<tr>
<td>Antispasmodic</td>
<td>Gilani et al., 1999</td>
</tr>
<tr>
<td>Antispasmodic activity</td>
<td>Amos et al., 1999</td>
</tr>
<tr>
<td>Antiplatelet or Antithrombotic effect</td>
<td>Shah et al., 1997</td>
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<tr>
<td>Anthelmintic activity</td>
<td>Bachaya et al., 2009</td>
</tr>
<tr>
<td>Anti-quorum sensing activities</td>
<td>Singh et al., 2009</td>
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</table>

Ahmadu et al., (2010) isolated acanilol A and acanilol B, from the stem bark of *Acacia nilotica* (L.) Del. The structures of the new compounds were established on the basis UV, NMR, and mass spectrometry. The new compounds were tested as kinase inhibitors against CDK1, GSK3, CK1, and DYRK1A, and acanilol B.

Amos et al., (1999) investigated seed of *Acacia nilotica* for contractile activity on the isolated guinea-pig ileum. The extract displayed sustained dose-related activity with the involvement of calcium.
Ayoub (1985) studied molluscicidal activity of the pods and stem bark of *Acacia* subsp. *nilotica*, *tomentosa* and *astringens* against the snail species *Bulinus truncatus* and *Biomphalaria pfeifferi*. The spray-dried powders of the pods and stem bark of *Acacia nilotica* subsp. *nilotica*, *tomentosa* and *astringens* prove to be promising vegetable molluscicides.

Bachaya et al., (2009) determined *in vitro* anthelmintic activity of methanolic extract of fruit of *Acacia nilotica* against *Haemonchus contortus* by the adult motility assay, the egg hatch test and the larval development assay. The data justified their use in traditional veterinary medicine.

Dafallah and Mustafa (1996) tested aqueous extracts of *Acacia nilotica* for anti-inflammatory, analgesic and antipyretic activities. The phytoconstituents like flavonoids, polysaccharides and organic acids may be responsible for pharmacological activities.

Gilani et al., (1999) suggested that antispasmodic action of *Acacia nilotica* is mediated through calcium channel blockade and which is responsible for the blood pressure lowering effect in the *in vivo* studies.

Kariuki and Njoroge (2011) tested extracts of *Acacia nilotica* against three test organism: *Staphylococcus aureus*, *Streptococcus pneumoniae* and *Escherichia coli* for their antimicrobial properties by bioassay method using the disk diffusion test. The findings indicated that *A. nilotica* have antimicrobial property.

Kaur et al., (2005) evaluated antimutagenic and cytotoxic effects of different extracts/fractions of *Acacia nilotica* prepared by maceration method. The potency order of different extracts was more or less similar in Ames assay as well as in cytotoxic assay. The activity of extract partially may be due to the presence of gallic acid and other polyphenols.

Koko et al., (2008) evaluated immunomodulating activity using luminol/lucigenin-based chemiluminescence assay. Results obtained showed that the fruits and barks of *Acacia nilotica*, possess average inhibitory effects on both types of phagocytes.
Chapter 2: Literature Review

Ouedraogo et al., (2004) determined the effect of an aqueous extract of \textit{Acacia nilotica} on milk production in rats. The extract was found to stimulate the synthesis and release of prolactin (PRL) could consequently have the properties claimed for lactating women.

Mahmood et al., (2012) investigated antimicrobial activities of crude methanolic extract of leaves of \textit{Acacia nilotica} L using agar well diffusion method against one gram-positive \textit{Bacillus subtilis} and three gram-negative \textit{Pseudomonas aeruginosa}, \textit{Escherichia coli} and \textit{Klebsiella pneumonia}. These results showed that plant extract have potential against bacterias, while against fungi their activity is not much effective.

Mann et al., (2011) investigated \textit{in vivo} antitrypanosomal activity of \textit{Acacia nilotica} against \textit{Trypanosoma brucei brucei}. This study has justified the claim that methanol extracts of stem bark could be useful in the management of trypanosomiasis.

Meena et al., (2006) reported the chemopreventive activity of aqueous extracts gum, flower and leaf of \textit{Acacia nilotica} on 7,12-dimethylbenz(a)anthracene (DMBA) induced skin papillomagenesis in male swiss albino mice. The activity of the leaf extract was most significant followed by the flower extract and then by gum.

Misar et al., (2007) studied antidiarrhoeal activity of bark of \textit{Acacia nilotica} against castor oil, magnesium sulphate induced diarrhoea and enteropooling activity. The bark significantly induced peristalsis in mice.

Rehman et al., (2011) investigated HCV by infecting HCV inoculums of 3A genotype in liver cells. \textit{Acacia nilotica} showed more than 50% reduction at non toxic concentration.

Shah et al., (1997) studied the antiplatelet aggregatory activity of the extract of \textit{A. nilotica} is mainly due to blockade of \( \text{Ca}^{2+} \) channels, although evidence also suggests the involvement of protein kinase C.

Siddhwaju et al., (1996) had studied nutritional and antinutritional characteristics and biological value of \textit{Acacia nilotica} seeds. The results imply that biological value, true digestibility and net protein utilization were significantly higher in processed seed than in raw seeds.
Sundarraj et al., (2012) investigated the inhibitory effect of *Acacia nilotica* leaves extract and γ-Sitosterol on cell proliferation, the apoptotic effect and cell cycle arrest in breast and lung cancer cells, results indicated that γ-Sitosterol, bioactive ingredients of extract exerts potential anticancer activity.

Salem et al., (2011) had studied anti-uveal melanoma activity guided fractionation of the methanolic extract of *Acacia nilotica* pods. The structures of the isolated compounds were elucidated on the basis of HRESIMS, NMR spectroscopy and CD data and isolated compounds were gallicatechin 5-O-gallate in addition to methyl gallate, gallic acid, catechin, catechin 5-O-gallate, 1-O-galloyl-β-D-glucose, 1,6-di-O-galloyl-β-D-glucose and digallic acid.

Kanekar et al., (1993) were tested *Acacia nilotica* (L.) Del. for their tolerance and growth on dyestuff wastewater containing phenol, aniline, and methyl violet. Results imply that it exhibited 100% survival with both untreated and treated wastewater, and growth (increase in height) was comparable to that of control plants.

Ayoub (1982) evaluated acetone, alcohol and aqueous extracts of fruits of *Acacia nilotica* against molluscicidal activity against the two snail species *Bulinus truncatus* and *Biomphalaria pfeifferi*. Results suggested that molluscicidal properties of this plant may well be due to high content of tannins.

Kaur et al., (2002) provided a correlation of the antimutagenic and chemopreventive activity of the barks of two commonly observed plants viz. *Acacia auriculiformis* and *Acacia nilotica* using the ames antimutagenicity assay and the mouse mammary gland organ culture (MMOC) model. These results exhibited good correlation between the antimutagenesis assay and the MMOC model, suggesting that these plants may contain active chemopreventive agents.

Kambizi and Afolayan (2001) presented findings of a survey of plants used for the treatment of sexually transmitted diseases (STDs) in the district. The finding suggested that *Acacia nilotica, Cassia abbreviate, Dichrostachys cinerea, Solanum incanum,*
Chapter 2: Literature Review

Vernonia amygdalina and Zanha africana are the most frequently used plants for the treatment of STDs.

Hussein et al., (2000) evaluated inhibitory effects on hepatitis C virus (HCV) protease (PR) using in vitro assay methods of one hundred fifty-two methanol and water extracts of different parts of 71 plants commonly used in Sudanese traditional medicine. Thirty-four extracts showed significant inhibitory activity. The eight extracts, methanol extracts of Acacia nilotica, Boswellia carterii, Embelia schimperi, Quercus infectoria, Trachyspermum ammi and water extracts of Piper cubeba, Q. infectoria and Syzygium aromaticum, were the most active.

2.3 Medicinal plants investigated for antidiabetic activity using different models

The medicinal plants with scientific investigation based on management approaches of diabetes are summarized as:


Analco (2007) showed significant hypoglycemic and antihyperglycemic of stem barks of several Mexican copalchis species, including Hintonia latiflora, Exostema caribaeum and a commercial mixture of Hintonia standleyana and E. caribaeum (CM) effects due to stimulation of insulin secretion and regulation of hepatic glycogen metabolism.

Babu (2002) studied the effect of Cassia kleinii on serum glucose levels in both normal and in alloxan-induced diabetic rats. The study revealed potent activity of plant extracts in both models.

Bavarva and Narasimhacharya (2008) suggested significant antidiabetic, hypolipaemic and antiperoxidative effects in non-insulin dependent diabetes mellitus rats in alloxan induced model. The high dose (450 mg/kg BW) was found to have more potential antioxidant activities compared with glibenclamide.
Cetto et al., (2005) studied the hypoglycemic effects of root extracts of *Malmea depressa* in streptozotocin induced diabetic rats. Oral application of extracts significantly lowered the plasma glucose levels in diabetic rats within three hours.

Chakrabarti et al., (2002) investigated antidiabetic and hypolipidemic activity of *Helicteres isora* in animal models. Ethanolic extract caused significant reduction in plasma glucose, triglyceride and insulin levels in diabetic mice.

Chattopadhyay et al., (1992) performed their research with leaves of *Vinca rosea* on glucose utilization and glycogen utilization by isolated rat hemi diaphragm.

Chattopadhyay (1999) compared blood sugar lowering activity of four important medicinal plants (*Azadirachta indica*, *Gymnema sylvestre*, *Catharanthus roseus* and *Ocimum sanctum*) against normal and streptozotocin-induced diabetic rat models. A. *indica* leaf extract was found to have most potent blood sugar lowering activity followed by *C. roseus*, *G. sylvestre* and *O. sanctum*.

Damge et al., (2007) evaluated that polymeric nanoparticle for preservation of insulin's biological activity. The antidiabetic effect was explained by the mucoadhesive properties of the polycationic polymer.

Dhanabal, et al., (2004) reported the hypoglycemic activity of *Coccinia indica* Wight & Arn. The alcoholic extract of *Coccinia indica* was found to be more active in reducing blood glucose level, this extract was subjected to further fractionation.

Eidi et al., (2006) investigated antidiabetic effect of garlic ethanolic extract (*Allium sativum* L.) in normal and streptozotocin-induced diabetic rats. Oral administrations of the garlic extract significantly decreased serum glucose, total cholesterol, triglycerides, urea, uric acid, creatinine, aspartate transminase and alanine transaminase levels, while increased serum insulin in diabetic rats but not in normal rats.

Eidi et al., (2007) investigated antidiabetic effect of *Trigonella-foenum graecum* L in normal and streptozotocin-induced diabetic rats. Results revealed that the antidiabetic effect of the extract was similar to that observed for glibenclamide.
Frode and Medeiros (2008) reviewed the *in vitro* and *in vivo* models of diabetes to investigate the mechanism of action of drugs with potential antidiabetic properties.

Ghost *et al.*, (2004) explained the hypoglycemic activity of *Ficus hisipida* in normal and diabetic albino rats. The probable mechanism is by estimating the glycogen content of liver, skeletal muscles and cardiac muscles, and glucose uptake by isolated rat diaphragm.

Gokce and Haznedaroglu (2008) evaluated antidiabetic, antioxidant and vasoprotective effects of *Posidonia oceanica* extract in alloxan diabetic rats. The results suggest that antidiabetic and vasoprotective effects of extract may be unrelated to its antioxidant properties.

Gupta *et al.*, (2005) demonstrated the hypoglycemic and antidiabetic activity of the water extract of *Annona squamosa* (custard apple) in diabetic animals with a view to explore its use for the treatment of diabetes mellitus in humans.

Habibuddin *et al.*, (2008) studied the effect of *Caralluma sinaica* (CS) on streptozotocin (STZ)-induced diabetic model as well as effect on oral glucose tolerance test. Administration of CS in different doses to normal animals caused significant decrease in glucose level.

Kaleem *et al.*, (2005) performed their research with aqueous extract of *Piper nigrum* and *Vinca rosea* flowers in alloxan induced diabetic rats once a day for four weeks these treatments led to lowering of blood sugar level and reduction in serum lipids.

Kannur *et al.*, (2006) screened antidiabetic activity of seed extracts of *Caesalpinia bonducella* in alloxan induced hyperglycemia. The antihyperglycemic action of the extracts may be due to the blocking of glucose absorption. The drug has the potential to act as antidiabetic as well as antihyperlipidemic.

Kar *et al.*, (2003) have performed experiments with thirty hypoglycemic medicinal plants and definite blood glucose lowering effects were observed within 2 weeks in alloxan induced diabetic albino rats.
Kesari et al., (2006) focused on the hypoglycemic activity of *Murraya koenigii* leaves in normal and alloxan induced diabetic rabbits. The finding from the study suggests that the aqueous extract of leaves may be prescribed for controlling diabetes mellitus.

Kesari et al., (2006) investigated hypoglycemic and antihyperglycemic activity of *Aegle marmelos* seed extract in normal and diabetic rats and extracts proved to be antidiabetic agent.

Kim and Kim, (2008) investigated the effect and mechanism of Korean red ginseng on stimulation of insulin release in isolated rat pancreatic islets. These findings suggest that it displays beneficial effects in the treatment of diabetes at least in part via the stimulation of insulin release in a glucose-independent manner.

Kumar et al., (2008) validated antidiabetic potential of *Phyllanthus reticulatus* in alloxan-induced diabetic mice and they suggested use of the plant in Bangladesh folk medicinal practices for the treatment for pain and diabetes-related disorders.

Logendra et al., (2006) evaluated ethanolic extract of *Artemisia dracunculus* L. for antidiabetic activity. The extract was examined as a possible aldose reductase (ALR2) inhibitor, a key enzyme involved in diabetic complications. These results suggest a use of the extract of *A. dracunculus* for ameliorating diabetic complications.

Ndiaye et al., (2008) had studied aqueous extract of the *Parinari excelsa* barks at different doses level for seven days on alloxan-induced diabetic rats. It induced a significant decrease of blood glucose on glucose-loaded normoglycaemic rats.

Njike et al., (2005) described that the hypoglycemic property of the aqueous and methanol extracts of the leaves of *Bersama engleriana* in normoglycemic rats.

Oliveira et al., (2008) investigated anti-diabetic effects of stem-bark extract of *Vatairea macrocarpa* at a different dose level for 22 days in normal and streptozotocin diabetic rats. These antidiabetic effects could be related to an improved insulin resistance.

Petruzzi and Bucalossi (1985) found the effect of vincamine and vincamine-papeverine combination on ethyrocyte flexibility in diabetic patient.
Ramkumar et al., (2007) examined the modulatory effects of *Gymnema montanum* leaves on glycoprotein levels in alloxan-induced diabetic rats. The evaluated parameters were blood glucose, plasma insulin, and plasma/tissue glycoproteins.


Raut and Gaikwad, (2006) evaluated antidiabetic activity of hydro-ethanolic extract of *Cyperus rotundus* in alloxan induced diabetes in rats, activity was attributed due to its *in vitro* antioxidant activity (DPPH radical scavenging model).

Ribnicky et al., (2006) examined the antihyperglycemic activity of an ethanolic extract of *Artemisia dracunculus* L. in diabetic and non-diabetic animals. The extract showed activity by increase the binding of glucagon-like peptide (GLP-1) to its receptor *in vitro*.

Roy et al., (2008) suggested that glycation-modified hemoglobin in diabetes mellitus enhanced catalytic iron and free radicals causing pathological complications. Experimental parameters reverted to their respective normal values after pelargonidin administration.

Sarkhail et al., (2007) investigated the effects of aerial parts of *Phlomis anisodonta* on streptozotocin (STZ)-induced diabetic rats by measuring fasting blood glucose, serum insulin, change in body weight, ferric reducing antioxidant power (FRAP), lipid peroxidation (LPO), and liver antioxidant enzymes.

Sarkhail et al., (2010) investigated the effects of methanolic extract of aerial parts of *Phlomis anisodonta* on streptozotocin (STZ)-induced diabetic rats by measuring fasting blood glucose, serum insulin, change in body weight, ferric reducing antioxidant power (FRAP), lipid peroxidation (LPO), and liver antioxidant enzymes including superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx).
Satyanarayan et al., (2006) studied the hypoglycemic and antihyperglycemic effect of alcoholic extract of *Euphorbia leucophylla* in normal and alloxan induced diabetic rats. The administration of extracts produced a significant blood glucose reduction in a dose dependent manner and elevated the serum insulin level in normal and diabetic rats.

Shokeen et al., (2008) had investigated the antidiabetic activity of 50% ethanolic extract of roots of *Ricinus communis* (RCRE) along with its bioassay-guided purification. The results postulated that *R. communis* seems to have a promising value for the development of a potent phytomedicine for diabetes.

Singh et al., (2001) detected hypoglycemic activity in dichloromethane: methanol extract of leaves and twigs of *C. roseus* (Apocynaceae) in STZ induced diabetic model. All the parameters of activity were normalized by treatment with the extract.

Singh et al., (2007) investigated the hypoglycemic and antidiabetic effect of single and repeated oral administration of the aqueous extract of *Cynodon dactylon* (Family: Poaceae) in normal and streptozotocin induced diabetic rats. These results clearly indicate that aqueous extract of plant has high antidiabetic potential along with significant hypoglycemic and hypolipidemic effects.

Sokneg et al., (2005) studied the effect of the ethanolic extract and fractions of *Bridella ndellensis stem* bark on the blood glucose levels in streptozotocin-induced types 1 and 2 diabetic rats on different prandial.

Soon and Tang (2002) investigated the hypoglycemic and anti-oxidant activities of the dried roots of *Morinda officinalis* in streptozotocin induced diabetic rats. The results indicate that the extracts possess hypoglycemic, hyperglycemic and anti-oxidant properties.

Srinivas et al., (2003) studied antidiabetic activity of leaves of *C. roseus* and produced dose–dependent reduction in blood glucose of both normal and diabetic rabbits by enhancing the secretion of insulin from the beta cells.

Sumana and Suryawanshi (2001) administered aqueous extracts of *V. rosea* flowers and leaves and concluded that *V. rosea* regulated the blood glucose level in alloxan diabetic male albino rats and also reversed changes in carbohydrates, protein, lipid metabolisms.

Venkatesh et al., (2008) suggested that ethanol extract of flowers of *Hibiscus rosasinensis* at doses of 250 mg/kg and 500 mg/kg significantly reduced the blood glucose level in both acute and sub acute treatments.

Venter et al., (2008) investigated the traditional antidiabetic uses of indigenous or naturalised South african plants using an optimized screening and scoring method.

Viana et al., (2004) studied the hypoglycemic and the antilipidemic effects of the aqueous extracts prepared from fresh leaves of the plant *C.sicyoides*. The results justify its popular use as an alternative medicine in type 2 diabetes mellitus.

Yadav et al., (2002) showed the hypoglycemic and antihyperglycemic activity of *Murraya Koenigii* leaves in diabetic rats. The diet caused a maximum reduction in blood sugar.

Zheng et al., (2008) had investigated, the antidiabetic effects of cysteiny1 metformin (CM), a newly synthesized agent, using alloxan-induced and streptozocin-induced model and has a protective effect on the antioxidant defense system and β-cell dysfunction in both type 1 and type 2 diabetes.

**2.4 Medicinal plants investigated for antioxidant activity using different models:**


Bakar et al., (2009) evaluated antioxidant activity of different parts of *Mangifera pajang* and *Artocarpus odoratissimus*. The results showed that kernel and peel from *M.*
pajang contains a broad range of polyphenol phytochemicals which might be responsible for the cytotoxicity activity against selected cancer cell lines.

Chan et al., (2009) assessed antioxidant properties of leaves and tea of ginger species. All methods of thermal drying (microwave, oven, and sun-drying) resulted in drastic declines in total phenolic content (TPC), ascorbic acid equivalent antioxidant capacity (AEAC), and ferric-reducing power (FRP), with minimal effects on ferrous ion-chelating ability and lipid peroxidation inhibition activity.

Danrong et al, (2009) studied the effect of water quality on the nutritional components and antioxidant activity of green tea extracts. Results suggested that the synergistic effect of catechins, caffeine, and other components might be more important than any single component in free radical scavenging.

Giovanelli and Buratti, (2009) compared polyphenolic composition and antioxidant activity of wild Italian blueberries and some cultivated varieties. Results showed that total phenolics and total anthocyanin concentrations were, respectively two fold and three fold higher in the wild fruits.

Lin et al., (2009) assessed antioxidant property of buckwheat enhanced wheat bread. Results showed that it has good antioxidant activity, reducing power and 1,1-diphenyl-2-picrylhydrazyl radical scavenging ability.

Mohsen and Ammar, (2009) investigated total phenolic contents and antioxidant activity of Corn tassel water, ethanol, methanol, acetone, hexane, chloroform, butanol, petroleum ether and methylene chloride extracts. Results revealed that ethanol exhibited the highest extraction ability for phenolic compounds, followed by methanol and water.

Naik et al., (2003) examined Momordica charantia Linn, Glycyrrhiza glabra, Acacia catechu, and Terminalia chebula as antioxidants. The results were found to be in agreement with the lipid peroxidation data showed maximum value of ascorbate equivalents.
Oke et al., (2009) evaluated antioxidant activities of the essential oil and the methanolic extract from *S. cuneifolia* by using DPPH radical scavenging, β-carotene linoleic acid bleaching and metal chelating activity assays. They concluded the minimum inhibitory concentration of plant extracts in different models.

Sharififar et al., (2009) screened crude extracts of *Teucrium polium* L. and isolated compounds for their antioxidant and free radical scavenging activities. It has been found that these compounds possess a broad spectrum of pharmacological effects including antioxidant, anticancer, anti-inflammatory, hypoglycemic, hepatoprotective, hypolipidemic, antibacterial and dantifungal properties.

Slusarczyk et al., (2009) showed the antioxidant properties of the different extracts from *Lycopus lucidus* and to correlate their antioxidant potential to the composition of polyphenols.

Socha et al., (2009) studied ten herb honeys of various origin revealed differences in their antioxidant activity and profiles of phenolic acids and flavonoids. Thyme herb honey had high quercetin content.

Zhang et al., (2009) studied antioxidant phenolic compounds from walnut kernels (*Juglans regia* L.) The results of this study suggested that the antioxidant activities of these phenolic compounds may be influenced by the number of hydroxyls in their aromatic rings.