2. LITERATURE REVIEW

2.1. Treatment of Diabetes

Emphasis is on managing short-term as well as long-term diabetes-related problems. There is an important role for patient education, nutritional support, self-glucose monitoring, as well as long-term glycaemic control. A scrupulous control is needed to help reduce the risk of long-term complications. In addition, given the associated higher risks of cardiovascular disease, lifestyle modifications must be implemented to control blood pressure and cholesterol by exercising more, smoking cessation, and consuming an appropriate diet (Susman JL et al. 1997).

2.2. Management of Diabetes without Drugs

Exercise, Weight and Diet control play an important role in management of diabetes.

Exercise: Regular exercise is of particular importance for diabetics. It ultimately helps you to keep your blood sugars within a normal range. By exercising, the cells in the body help to make insulin more effective because it makes the body's cells more sensitive to insulin. Consequently, individuals who have to inject insulin daily will have to inject less insulin if their bodies are using it more efficiently. Patients with type 1 or type II diabetes have an increased risk of coronary artery disease.

Physical exercise is a key component of lifestyle modification that can help individuals prevent or control type II diabetes. Although diet is probably more important in the initial phases of weight loss, incorporating exercise as part of a weight –loss regimen helps maintain weight loss and prevent weight regain. Mild to moderate activity levels have been associated with a lower risk of developing diabetes or pre-diabetes. 30 minutes of moderate physical
activity daily may offer protection from diabetes. Greater levels of physical activity are associated with lower risks of developing diabetes in women compared with lesser levels of activity. These studies indicate that exercise should be a mainstay of primary prevention of diabetes (Michael JF 2007, Stewart M 2008).

**Weight**: It can be important factor in diabetics because it can make ones body become resistant to insulin. Exercise helps to keep weight down because calories are burned when one exercises. If fewer calories are consumed than one can burn, weight can be lost. A recent study demonstrated that both women and men who have a BMI > 35 kg/ m2 had a 20-fold increase in their risk of developing diabetes compared to people with a BMI of 18.5 -24.9 kg/m2. Obese people also have a high incidence of hypertension and hyperlipidemia compared to nonobese people, which may further increase their risk of microvascular and macrovascular complications of diabetes. Weight loss also has been shown to decrease systolic and diastolic blood pressure and LDL cholesterol and lipid levels in obese diabetic patients.

**Diet**: The diet plays a tremendous role in the management of diabetes because it is important to keep your blood sugar within a normal range. The persons with diabetes who are taking a fixed dosage of insulin have to manually adjust their diet so that their blood sugar will be within a normal range. Substantial dietary restriction to 1,100 kcal/day has been shown to decrease fasting blood glucose of obese patients with diabetes and even in those without diabetes in as few as 4 days (Michael JF 2007, Stewart M 2008, Kirkwood L 2007).

**Carbohydrates**: Carbohydrates are the body's main source of energy. Starches and sugars are carbohydrates and they are both broken down into glucose at approximately the same speed.
Foods, such as candy and jams, can cause diabetes. Carbohydrates raise the blood sugar much more rapidly than fats and proteins (Beaser R 1995).

**Protein.** The body uses protein as the second major nutrient to build body tissue as well as repair body tissue. Proteins consist of foods such as meats, eggs, cheese, peanut butter, and tofu. The best sources of protein are those that are low in fat, such as lean meat and skinless poultry. Proteins contain enzymes. Some enzymes are responsible for breaking down starches into sugars. Proteins also slow the release of sugars into the bloodstream (Michael JF 2007).

**Fat.** The third major nutrient needed by the body is fat. Fats are important because they carry fatty acids and vitamins in the body. It can be found in such things as cheese, margarine, butter, meat, milk, and vegetable oils. All fats are high in calories. Fats, like proteins, slow the release of sugars into the bloodstream. Because saturated fats are the major dietary determinants of serum LDL cholesterol levels, people with diabetes should strive to keep saturated fat consumption to <7% of total daily calories and to minimize consumption of trans-fatty acids. Cholesterol consumption should be <200 mg/day. Diets high in fish oil may decrease the risk of cardiovascular disease. Being a diabetic does not mean that one has to give up all of the foods that we enjoy, but we have to pay particularly close attention to the meals that we eat (Michael JF 2007).

### 2.3. Allopathic Treatment of Diabetes Mellitus

Conventional treatment of diabetes in allopathic medicinal system revolves around the use of following drugs (Tripathi KD 2010).

a) Insulin: Rapid acting, Short acting, Intermediate acting, Long acting

b) Sulfonylurea First generation,- Second generation
c) Biguanides

d) Meglitinide/Phenylalanine analogues

e) Thiazolidinediones

f) Glucosidase Inhibitors

g) Novel drugs in diabetes

**Insulin**: Secretion of insulin from beta cells of pancreas, which has a overall effects to favour storage of fuel. Insulin also facilitates glucose transport across cell membrane & glycogen synthesis from glucose in liver, muscle and fat by stimulating the enzyme glycogen synthetase. It inhibits gluconeogenesis from protein in liver and lipolysis in adipose tissue and favours triglyceride synthesis (Drug Today 2012).

**Highly Purified Insulin Preparations**

Pork insulin, being more homologous to human insulin, is less immunogenic and is used. Gel filtration reduces proinsulin content to 50-200 ppm, but pancreatic peptides and insulin derivatives remain; the preparation is called — single pork insulin. It has significant immunogenicity. Further purification by ion-exchange chromatography removes most contaminants and reduces proinsulin to< 10 ppm. These preparations are termed —Highly purified or Monocomponent (MC) insulins. Immunogenicity of pork MC insulins is similar to that of human insulins. Moreover, MC insulins are more stable, cause less insulin resistance or injection site lipodystrophy (Tripathi KD 2010).

**Human insulins**

In the 1980s, the human insulin (having the same amino acid sequence as human insulin) were produced by recombinant DNA technology in *Escherichia coli* –proinsulin recombinant
bacterial (prb) and in yeast- precursor yeast recombinant (pyr) or by enzymatic modification of porcine insulin. Human insulin is more water soluble as well as hydrophobic than porcine or bovine insulin. It has slightly more rapid s.c absorption, earlier and more defined peak an slightly shorter duration of action (Tripathi KD 2010).

2.4. Novel Drugs in Diabetes

**Guargum:** It is a dietary fibre (polysaccharide) from Indian cluster beans (Guar), which forms a viscous get on contact with water. Administered just before or mixed with food, it shows gastric emptying, intestinal transit and carbohydrate absorption: postprandial glycaemia is suppressed but overall lowering of blood glucose is marginal. It also reduces serum cholesterol by about 10% (Tripathi KD 2010).

**Glucomannan:** This powdered extract from tubers of Konjar is promoted as a dietary adjunct for diabetes. It swells in the stomach by absorbing water and is claimed to reduce appetite, blood sugar, serum lipids and relieve constipation.

**Exenatide:** The glucagon-like peptide-1 (GLP-1) is an important incretin that is released from the gut in response to oral glucose. Exenatide is a synthetic GLP-1 analogue, resistant to enzyme dipeptidyl peptidase-4 DPP-4, but with similar action, viz, enhancement of postprandial insulin release , suppression of glucagon release and appetite as well as showing of gastric emptying (Tripathi KD 2010).

**Sitagliptin:** This orally active inhibitor of DPP-4 prevents degradation of endogenous GLP-1 and other incretins, potentiating their action, resulting in limitation of postprandial hyperglycaemia.
Pramlintide: This synthetic amylin (a polypeptide produced by pancreatic β cells which reduces glucagon secretion from α cells and delays gastric emptying) analogue attenuates postprandial hyperglycaemia when injected s.c. just before a meal, and exerts a centrally mediated anorectic action (Tripathi KD 2010).

Vogliobose: It inhibits the hydrolase (alpha glucosidase) enzyme for disaccharides that catalyzes decomposition of disaccharides into monosaccharides in the intestine. Thereby, it delays the digestion and absorption of carbohydrates, resulting in improvement of postprandial hyperglycaemia (Drug Today 2012).

Chromium picolinate: It is a nutritional supplement that works to increase the efficiency of insulin to optimal levels.

Vildagliptin: a new hypoglycemic agent dipeptidyl peptidase-4 (DPP-4) inhibitor. It works by increasing the amount of two incretin hormones found in the body, called glucagon-like peptide-1 (GLP-1) and glucose dependent insulinotropic peptide (GIP). GLP-1 and GIP have two main actions that help to control blood glucose. They stimulate the pancreas to produce insulin in response to increasing levels of glucose in the blood. GLP-1 also reduces the production of glucagon, GLP-1 and GIP are normally broken down by an enzyme in the body called dipeptidyl peptidase-4 (DPP-4). Vildagliptin works by binding to this enzyme and preventing it from breaking down the GLP-1 and GIP. This increases the levels of these hormones in the body and so increases their effect on controlling blood sugar. Another drug in this category is Linagliptin which works by blocking the DPP-4 enzyme, which releases insulin boosting hormones that help control blood sugar levels (Malik JA 2012).
2.5. Recent Advances

a) Pancreas transplantation
b) Islet cell transplantation
c) Artificial pancreas
d) Stem cell approach
e) Gene therapy approach
f) Nanotechnology

Pancreas transplantation

Highly recommended for patients who require a kidney transplant.

Islet cell transplantation

Highly used approach in humans to cure type I diabetes. Islets cells are injected into the patient liver, where they begin to produce insulin. The islet cells seem to produce insulin well in that environment. The patients’ body treats the new cells just as it would do to any other foreign body. The immune system will attack the cells as it would do to a bacterial infection. Thus, the patient also needs to undergo treatment involving immune suppression, which reduces immune system activity (Robertson R Paul 1999).

Artificial pancreas

Artificial pancreas involves implantation of bio-engineered tissue containing islet cells, which would secrete the amounts of insulin, amylin and glucagon needed in response to glucose (Klonoff DC 2003).

Stem cell approach

Islet cells are developed from stem cells taken from umbilical cord blood of newborn babies.
Gene therapy approach

Gene therapy can be used to manufacture insulin directly, consisting of viral vectors containing the insulin sequence, is digested and delivers its genes to the upper intestines. Those intestinal cells will then behave like any viral infected cell and will reproduce the insulin protein.

The virus can be controlled to infect only the cells which respond to the presence of glucose, such that insulin is produced only in the presence of high glucose levels. Gene therapy is also used to cure patients having β cell destruction. It is also used to turn duodenum cells into β cells, which produce insulin and amylin. Naturally β cells will produce insulin in proportional response to carbohydrates consumed (Welsh N 1999, Yamaoka T 2001).

Nano-technology approach

To cure diabetes type I patients many nanobots are injected into the patient blood stream. These nanobots synthesize insulin and secrete it according to the level of glucose they would sense.

2.6. Herbal Medicine: An Overview

Medicinal plants/Herbal medicines have always been the principle source of medicine in India since ancient past and presently they are becoming popular throughout the developed countries. Besides, they also play an important role in the lives of tribal and rural people, particularly in remote part of developing countries. Obviously, these plants help in alleviating human suffering. These plants are being integrated to the field of foods as additives, beverage and cosmetics. There has been a rapid extension of allopathic system of medical treatment in our country during the past century. However, these drugs have adverse effect on human
health and people are going back to nature with hope of safety and security. One the other hand, the drug obtained from the medicinal plants are safe, cheaper, easily available and with no fear of any side effects. Moreover, these are more compatible the human body constitution and suits to the local and cultural need of the people. The indigenous method of preparation maintains the purity of the drug. Furthermore, traditional folk healers treat with kindness, grace, patience and tolerance, which play a vital role in healing process today (Dwivedi Sumeet 2010, Dwivedi Abhishek 2010).

Medicinal plants generated commercial demand for pharmacopoeial drugs and their products in India. Efforts have been made in recent years to introduce many of these drug plants to common people. The agronomical practices for growing few medicinal plants have been developed and there is now localized cultivation of these medicinal plants commercially in many part of our country (Dwivedi Sumeet 2011, Kohli Seema et al. 2011).

It is evident that many valuable herbal drugs have been discovered by knowing that a particular plant was used by the ancient folk healers for the treatment of some kind of ailments. Moreover, the medicinal plant wealth are our national heritage and it seems to be the first and foremost line of defense for the treatment of various diseases mostly tribal and rural communities and is a worth scientific study (Dwivedi Sumeet 2013).

The urgent need of hour is the evolution of an action plan for spreading awareness about the value and importance of medicinal plants. In addition to curing various ailments, these plants will add to the national needs export potential. We have to link the indigenous traditional knowledge with modern technology. With the coming of chemical revolution, the medicinal plants, which were once used by the primitive folk healers and traditional medicine men, have found wide acceptance and a place of pride in the modern system of medicine. Their chemical
examination revealed that they possess chemical compounds of great biological activity. Indeed, these plants are capable to cure some incurable diseases and also cure the diseases from root. People suffering from chronic diseases and after losing all hops from allopathic medicine, turn their eyes towards herbal medicine. The add advantage is that the medicinal plants are easily available, cheaper and without any side effect. Hence, the prime need is to make uses of medicinal plants for solving the health problem and major ailments of the people (Kaul Shefali 2010, Dwivedi Sumeet 2009, Tripathi Rakesh 2010).

2.7. Herbals as Anti-Diabetics


Classification of herbal antidiabetics

Based on the possible mechanism of action, reported plant antidiabetics may be classified as follows (Grover JK 2002, Piyush et al. 2006).

Some of these plants are shown below:


- *Momordica charantia*
Cuminum nigrum  
Panax ginseng  
Pongamia pinnata  

Plants increasing insulin secretion from beta cells of pancreas (Piyush et al. 2006)

Panax ginseng,  
Azadirachta indica,  
Syzygium cumini,  
Eugenia jambolana,  
Pterocarpus marsupium,  
Euphorbia prostate,  
Fumaria parviflora,  
Bridelia ferruginous,  
Cassia tamala,  
Cassia nigrum,  
Swertia chirayita  

Plants acting by regeneration of beta cells of islets of Langerhans (Piyush et al. 2006)

Morusbomoysis,  
Pterocarpus marsupium,  
Tinospora cordifolia,  
Tinospora crispa,  
Gymnema sylvestre
Plants inhibiting glucagon secretion from alpha cells in pancreas (Piyush et al. 2006)

- *Ke-Tang-Ling*

Plants reducing absorption of glucose from gastrointestinal tract (Piyush et al. 2006)

- *Cyamopsis tetragonoloba,*
- *Cuminum nigrum,*
- *Ocimum sanctum,*
- *Mangifera indica*

Plants inhibiting aldose reductase activity (Piyush et al. 2006)

- *Paeonia latiflora,*
- *Glycyrrhiza glabra,*
- *Atracyloides lancea,*
- *Cinnamomum,*
- *Phellodendron amurense,*
- *Aralia elata*

Plants increasing glucose utilization (Piyush et al. 2006)

- *Zingiber officinale,*
- *Nelumbo nucifera*

Plants reducing lactic dehydrogenase and gamma glutamyl tranpeptidase (Piyush et al. 2006)

- *Lythrum salicaria*
Plants inhibiting glycogen metabolizing enzymes (Piyush et al. 2006)

- Bryonia alba

Plants acting on liver glycogen (Augusti KT 1973).

- Allium sativum,
- Coccinia indica

Plants increasing glyoxalase I activity in liver (Piyush et al. 2006)

- Trigonella foenum graecum

Plants increasing glucose uptake in lipocytes (Piyush et al. 2006)

- Swertia japonica

Plants inhibiting glucose -6-phosphate system (Piyush et al. 2006)

- Bauhinia megalandra

Plants having oxygen radical scavenging activity (Piyush et al. 2006, Dubey DK 1987, Jain SC 1987)

- Momordica charantia,
- Pterocarpus marsupium,
- Trigonella foenum graecum,
- Ocimum sanctum,
- Eugenia jambolana,
- Tinospora cordifolia,
- Macuna pruriens
Table 2: Anti-Diabetic Medicinal Herbs with their Traditional Uses

<table>
<thead>
<tr>
<th>S/No.</th>
<th>Botanical Name (Family)</th>
<th>Local Name</th>
<th>Part Use</th>
<th>Habit</th>
<th>Traditional therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Abelomoschus esculentus</em> well (Malvaceae)</td>
<td>Dheros</td>
<td>Fruit</td>
<td>Herb</td>
<td>Two vertically dissected fresh fruit are soaked overnight in ½ glass cold water and that leech ate water is taken every morning.</td>
</tr>
<tr>
<td>2</td>
<td><em>Abrus precatorius</em> L. (Fabaceae)</td>
<td>Ratti (Gumchi)</td>
<td>Leaves</td>
<td>Climbing</td>
<td>Juice twice a 25 day.</td>
</tr>
<tr>
<td>3</td>
<td><em>Aegle marmelos</em> Corr. (Rutaceae)</td>
<td>Beal</td>
<td>Leaves</td>
<td>Tree</td>
<td>One gram gum is eaten along with betleafe once daily.</td>
</tr>
<tr>
<td>4</td>
<td><em>Allium cepa.</em> (L.) (Liliaceae)</td>
<td>Pyaz</td>
<td>Bulb</td>
<td>Herb</td>
<td>Use of raw vegetable along with rice.</td>
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<tr>
<td>5</td>
<td><em>Allium sativum</em> (L.) (Liliaceae)</td>
<td>Lesun</td>
<td>Bulb</td>
<td>Herb</td>
<td>A raw bulb are eaten once daily</td>
</tr>
<tr>
<td>6</td>
<td><em>Artocarpus heterophyllus</em> Lamk (Moraceae)</td>
<td>Katahal</td>
<td>Leaves</td>
<td>Tree</td>
<td>About ½ cup juice of fresh tender leaves is taken once daily</td>
</tr>
<tr>
<td>7</td>
<td><em>Andrographis paniculata</em> Ness Nila Vaembu. (Acanthaceae)</td>
<td>Kalmegh</td>
<td>Leaves</td>
<td>Herb</td>
<td>Decoction drink 3 time per day</td>
</tr>
<tr>
<td>8</td>
<td><em>Annona squamosa</em> L. Sita (Annonaceae)</td>
<td>Sitaphal</td>
<td>Leaves</td>
<td>Tree</td>
<td>Powder with water daily in the morning</td>
</tr>
<tr>
<td>9</td>
<td><em>Aristolochia bracteolata</em> Retz. Israrmuli (Aristolochiaceae)</td>
<td>Kidmar</td>
<td>Leaves</td>
<td>Herb</td>
<td>Powder with water daily in the morning</td>
</tr>
<tr>
<td>10</td>
<td><em>Aspergous racemosus</em> Willd. (Liliaceae)</td>
<td>Satawar</td>
<td>Tubrous root</td>
<td>Herb</td>
<td>Powder mixed with leaf powder <em>Gymnema salvester</em> twice per day for 30 days</td>
</tr>
<tr>
<td>No.</td>
<td>Plant Name</td>
<td>Part Used</td>
<td>Medicinal Uses</td>
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<tr>
<td>11</td>
<td>Azadirachta indica (A) Juss. (Miliaceae)</td>
<td>Neem Flower Tree</td>
<td>Roasted flower or bark powder with bulfer milk for 40 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Acallypha Indica (L.) (Euphorbiaceae)</td>
<td>Kuppi Leaves Herb</td>
<td>Leaf juice two tea spoon full is given daily a one month for diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Argyeia nervosa (Burm. F.) Boj (Convolvulaceae)</td>
<td>Samdar kapat Leaves Herb</td>
<td>Pills made from the leaf past is given to diabetes patients for a long times.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Alpinia galona (L.) SW. (Zingiberaceae)</td>
<td>Kulangan Root Herb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Aloe berbandis (L.) Burm. F. (Liliaceae)</td>
<td>Gwarpatha Leaf Herb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Atropa belladonna (Solanaceae)</td>
<td>Cheelatubar Seed Tree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Bauhinia variegata L. (Caesalpiniaae)</td>
<td>Kachnar Root Tree</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>18</td>
<td>Boerhaavia diffusa L. (Nyctaginaceae)</td>
<td>Itsit Leaves Herb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Benincasa hispida (Cucurbitaceae)</td>
<td>Petha Seed Climber</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>20</td>
<td>Bacopa monnerii (L.) Penn. (Scrphulariaceae)</td>
<td>Nariabrahmi Leaves Herb</td>
<td>Aqueous leaf juice is given twice a day for one month for diabetes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Butea monosperma (Lamk) Taub (Fabaceae)</td>
<td>Dhak (Palas) Leaves Tree</td>
<td>Aqueous extract of leaves and fruit is given 2 tea spoon full once day for diabetes for a long times.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Bougainvillea spectabilis (Willd) (Nyctaginaceae)</td>
<td>Bogainvilla Leaves Shrub</td>
<td>Past made into pills twice per day for 25 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Berrya cordifolia (Teliaceae)</td>
<td>Burret Leaves Tree</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>No.</td>
<td>Scientific Name</td>
<td>Common Name</td>
<td>Part Used</td>
<td>Plant Type</td>
<td>Notes</td>
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<tr>
<td>24</td>
<td><em>Chonemorpha fragrans</em> (Apocynaceae)</td>
<td>Garphedaro</td>
<td>Root</td>
<td>Shrub</td>
<td>-</td>
</tr>
<tr>
<td>25</td>
<td><em>Chlorophyllum borivilanum</em> Roxb. (Liliaceae)</td>
<td>Safed Musli</td>
<td>Root</td>
<td>Herb</td>
<td>-</td>
</tr>
<tr>
<td>26</td>
<td><em>Caesalpinia pulcherrima</em> L. Roxb. (Caesalpiniaceae)</td>
<td>Mayilkonnal (Gulutora)</td>
<td>Leaves</td>
<td>Shrub</td>
<td>-</td>
</tr>
<tr>
<td>27</td>
<td><em>Crous sativus</em> L. (Iridaceae)</td>
<td>Kesar</td>
<td>Flower</td>
<td>Herb</td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td><em>Cassia sophera</em> L. (Caesalpiniaceae)</td>
<td>Thaonum</td>
<td>Bark</td>
<td>Shrub</td>
<td>Bark and powder seed mixed with honey is given in diabetes</td>
</tr>
<tr>
<td>29</td>
<td><em>Cassia fistula</em> (L.) (Caesalpiniaceae)</td>
<td>Amaltas</td>
<td>Fruit</td>
<td>Tree</td>
<td>Fruit pulp is given for diabetes</td>
</tr>
<tr>
<td>30</td>
<td><em>Cassia auriculata</em> L. (Caesalpiniaceae)</td>
<td>Aauaria</td>
<td>Leaves</td>
<td>Shrub</td>
<td>Juice for 20 days</td>
</tr>
<tr>
<td>31</td>
<td><em>Cassia tora</em> L. (Caesalpiniaceae)</td>
<td>Chakora</td>
<td>Leaves</td>
<td>Herb</td>
<td>Leaf juice for 20 days</td>
</tr>
<tr>
<td>32</td>
<td><em>Cassia occidentalis</em> L. (Caesalpiniaceae)</td>
<td>Pelaya</td>
<td>Leaves</td>
<td>Shrub</td>
<td>Powder with milk twice a day for 20 days</td>
</tr>
<tr>
<td>33</td>
<td><em>Cantharanthus roseus</em> (L.) G Don (Apocynaceae)</td>
<td>Sadabahar</td>
<td>Leaves</td>
<td>Herb</td>
<td>Leaf juice is given for diabetes</td>
</tr>
<tr>
<td>34</td>
<td><em>Centella asiatica</em> (L.) Urb. (Apiaceae)</td>
<td>Brahmi</td>
<td>Leaves</td>
<td>Herb</td>
<td>Leaf juice is given for the treatment to diabetes for a long time</td>
</tr>
<tr>
<td>35</td>
<td><em>Cissampelos pareirs</em> (L.) (Menispermaceae)</td>
<td>Akanadi</td>
<td>Root</td>
<td>Climber</td>
<td>The root powder with water is taken once a day for 40 days treating diabetes.</td>
</tr>
<tr>
<td>No.</td>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Part Used</td>
<td>Plant Type</td>
<td>Description</td>
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<td>-----------------------------------------------------------------------------</td>
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<tr>
<td>36</td>
<td>Clerodendrum multiflorum</td>
<td>(Burm) O.Ketze (Verbenaceae)</td>
<td>Arni Whol plant</td>
<td>Shrub</td>
<td>Aqueous extract of the plant is given for treatment of diabetes.</td>
</tr>
<tr>
<td>37</td>
<td>Clitoria ternatea</td>
<td>(L.) (Fabaceae)</td>
<td>Aparajita Flower</td>
<td>Twining</td>
<td>The flower juice is given for controlling diabetes.</td>
</tr>
<tr>
<td>38</td>
<td>Coccinia grandis</td>
<td>(L.) vogit. (Cucurbitaceae)</td>
<td>Kundru Leaves</td>
<td>Shrub</td>
<td>Aqueous extract of the roots leaves and mucilage from our fruit used for diabetes.</td>
</tr>
<tr>
<td>39</td>
<td>Cajanus cajan</td>
<td>(L.) millsp. (Papilionaceae)</td>
<td>Arher Leaves</td>
<td>Shrub</td>
<td>About 2 tea spoon full juice is given once daily with few drop of honey</td>
</tr>
<tr>
<td>40</td>
<td>Camellia sinensis</td>
<td>(L.) O Ktze. (Theaceae)</td>
<td>Cha Leaves</td>
<td>Tree</td>
<td>Eaten raw</td>
</tr>
<tr>
<td>41</td>
<td>Cinnamomum verum</td>
<td>J.S. Presl (Lauraceae)</td>
<td>Daruchini Bark</td>
<td>Tree</td>
<td>½ tea spoon dust with tea is given twice daily in empty stomach</td>
</tr>
<tr>
<td>42</td>
<td>Cocos nucifera</td>
<td>L. (Arecaaceae)</td>
<td>Coconut Fruit</td>
<td>Tree</td>
<td>Kernel and eaten daily</td>
</tr>
<tr>
<td>43</td>
<td>Cocolus hirsutus</td>
<td>(L.) diels (Menipermaceae)</td>
<td>Jamtikibel Leaves</td>
<td>Climber</td>
<td>Leaf of juice given for diabetes</td>
</tr>
<tr>
<td>44</td>
<td>Costus mercicanus</td>
<td>(kocnig) (Zingiberaceae)</td>
<td>Costus Leaves</td>
<td>Herb</td>
<td>One leaves daily eaten</td>
</tr>
<tr>
<td>45</td>
<td>Cuminum cyminum</td>
<td>m.L. (Apiaceae)</td>
<td>Shasha Fruit</td>
<td>Climber</td>
<td>To reduce Sugar a freshly collected green fruit should be</td>
</tr>
<tr>
<td>46</td>
<td>Cuminum cuminum</td>
<td>m.L. (Apiaceae)</td>
<td>Jeera Seed</td>
<td>Herb</td>
<td>About 2mg. Seed powder is taken with once daily</td>
</tr>
<tr>
<td>47</td>
<td>Carica papay</td>
<td>L. (Caraceae)</td>
<td>Papeta Fruit</td>
<td>Tree</td>
<td>Juice is drunk 2 times per daily.</td>
</tr>
<tr>
<td>48</td>
<td>Cornus officinalis</td>
<td>Siebdet Zuee (Cornaceae)</td>
<td>Cherry Pseudocarp</td>
<td>Shrub</td>
<td>-</td>
</tr>
</tbody>
</table>

Institute of Pharmaceutical Science & Research Center, Bhagwant University, Ajmer (Raj.)
<table>
<thead>
<tr>
<th>No.</th>
<th>Plant Name</th>
<th>Part Used</th>
<th>Plant Type</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td><em>Cressa cretica</em> L.</td>
<td>Rudrar anti</td>
<td>Whole plant</td>
<td>Shrub</td>
</tr>
<tr>
<td>50</td>
<td><em>Cyamopsis tetragonoloba</em> (L.) (Leguminosceae)</td>
<td>Guargum</td>
<td>Seed</td>
<td>Shrub</td>
</tr>
<tr>
<td>51</td>
<td><em>Hyptis suaveolensis</em> Well. (Ranunculaceae)</td>
<td>Mameera</td>
<td>Rhizome</td>
<td>Herb</td>
</tr>
<tr>
<td>52</td>
<td><em>Datura metel</em> Linn. (Solanaceae)</td>
<td>Dhatura (Black)</td>
<td>Seed</td>
<td>Shrub</td>
</tr>
<tr>
<td>53</td>
<td><em>Daucas carota</em> Linn. Var. sativa (Umbelliferae)</td>
<td>Gajara</td>
<td>Root</td>
<td>Herb</td>
</tr>
<tr>
<td>54</td>
<td><em>Diospyros malabarica</em> (Desr.) Kostel. (Ebenaceae)</td>
<td>Tendu</td>
<td>Bark</td>
<td>Tree</td>
</tr>
<tr>
<td>55</td>
<td><em>Dioscorea alata</em> (Dioscoreaceae)</td>
<td>Chuprialu</td>
<td>Tubrous root</td>
<td>Herb</td>
</tr>
<tr>
<td>56</td>
<td><em>Dalbaergia sisso</em> Roxb. (Fabaceae)</td>
<td>Talhi (Shishum)</td>
<td>Gum</td>
<td>Tree</td>
</tr>
<tr>
<td>57</td>
<td><em>Emblica officinalis</em> (Euphorbiaceae)</td>
<td>Amla</td>
<td>Dry fruit</td>
<td>Tree</td>
</tr>
<tr>
<td>58</td>
<td><em>Eupatorium purpucum</em> L. (Astraceae)</td>
<td>Queen of the meadow root</td>
<td>Root</td>
<td>Herb</td>
</tr>
<tr>
<td>59</td>
<td><em>Ficus carical</em> L. (Moraceae)</td>
<td>Anjir</td>
<td>Fruit</td>
<td>Tree</td>
</tr>
<tr>
<td>60</td>
<td><em>Ficus benghalensis</em> L. (Moraceae)</td>
<td>Bergad</td>
<td>Bark</td>
<td>Tree</td>
</tr>
<tr>
<td>No.</td>
<td>Species Description</td>
<td>Part</td>
<td>Plant Type</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
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<td>------------</td>
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<tr>
<td>61</td>
<td><em>Ficus religiosa</em> L. (Moraceae)</td>
<td>Bark</td>
<td>Tree</td>
<td>Bark extract is given for diabetes</td>
</tr>
<tr>
<td>62</td>
<td><em>Ficus recomosus</em> L. (Moraceae)</td>
<td>Fruit</td>
<td>Tree</td>
<td>Flower used in jaundice one flower eats daily one week to cure jaundice.</td>
</tr>
<tr>
<td>63</td>
<td><em>Ficus glomer</em> Roxb. (Moraceae)</td>
<td>Young fruit</td>
<td>Tree</td>
<td>Juice twice a day for 20 days</td>
</tr>
<tr>
<td>64</td>
<td><em>Foeniculum vulgare</em> Mill (Apiaceae)</td>
<td>Leaves</td>
<td>Herb</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td><em>Fraxinus excelsior</em> (oleaceae)</td>
<td>Seed</td>
<td>Tree</td>
<td>Anti diabetic</td>
</tr>
<tr>
<td>66</td>
<td><em>Gymnema sylvestre</em> (Retz.) schult (Asclepidaceae)</td>
<td>Leaves</td>
<td>Climber</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td><em>Glycosmic pentaphylla</em> (Retz.) DC. (Rutaceae)</td>
<td>Leaves</td>
<td>Shrub</td>
<td>Leaf oil is given for diabetes</td>
</tr>
<tr>
<td>68</td>
<td><em>Gycine max</em> L. (Merr.) (Papilionaceae)</td>
<td>Seed</td>
<td>Herb</td>
<td>Used of vegetable in curry</td>
</tr>
<tr>
<td>69</td>
<td><em>Gossypium herbaceum</em> L. (Malvaceae)</td>
<td>Seed</td>
<td>Shrub</td>
<td>About 2m. raw seed are eaten twice daily</td>
</tr>
<tr>
<td>70</td>
<td><em>Galega officinalls</em> (Leguminaceae)</td>
<td>Whol plant</td>
<td>Herb</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td><em>Gardenia tailensis</em> D. (Rubiaceae)</td>
<td>Flower</td>
<td>Tree</td>
<td></td>
</tr>
<tr>
<td>72</td>
<td><em>Himidesmus indica</em> (L.) R. Br. (Asclepiasaceae)</td>
<td>Root</td>
<td>climber</td>
<td>Aqueous extract of the roots one table spoon full is given for 9 day for the treatment of diabetes.</td>
</tr>
<tr>
<td>No.</td>
<td>Plant Name</td>
<td>Part Used</td>
<td>Source</td>
<td>Dosage</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>-----------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>73</td>
<td><em>Holarrhena pubescens</em> Wall. Exg. Don (Apocynaceae)</td>
<td>Seed</td>
<td>Tree</td>
<td>About 2gm. Seed are soaked in water overnight and glass of lecchate cold water is taken in empty stomach.</td>
</tr>
<tr>
<td>74</td>
<td><em>Hydnoearpus kurzii</em> Warb. (King) (Flaciourtiaceae)</td>
<td>Seed</td>
<td>Tree</td>
<td>About 1gm seed powder is taken orally twice daily.</td>
</tr>
<tr>
<td>75</td>
<td><em>Holoptele Intefitoflia</em> (Roxb.) planeh. (Ulmalaceae)</td>
<td>Leaves</td>
<td>Tree</td>
<td>-</td>
</tr>
<tr>
<td>76</td>
<td><em>Ipomoca Mauritian Jacq.</em> (Convolvalaceae)</td>
<td>Root</td>
<td>Climber</td>
<td>About ½ cup fresh root extract is taken once daily</td>
</tr>
<tr>
<td>77</td>
<td><em>Kyllinga hemoralis</em> (Forester) Dandy (Cyperaceae)</td>
<td>Root</td>
<td>Herb</td>
<td>-</td>
</tr>
<tr>
<td>78</td>
<td><em>Madhuca indica</em> (Koenig) <em>Macbrida</em> (Sapotaceae)</td>
<td>Inner bark</td>
<td>Tree</td>
<td>-</td>
</tr>
<tr>
<td>79</td>
<td><em>Muhiamatera spatona</em> (Cucurbitaceae)</td>
<td>Leaves</td>
<td>Climber</td>
<td>-</td>
</tr>
<tr>
<td>80</td>
<td><em>Mangifera indica</em> Linn. (Anacardiaceae)</td>
<td>Leaves</td>
<td>Tree</td>
<td>Oral administration of aqueous extract of the leaves gm/kg body weight is commended.</td>
</tr>
<tr>
<td>81</td>
<td><em>Manilkara sapota</em> (L.) P. Roen (Sapotaceae0</td>
<td>Root</td>
<td>Tree</td>
<td>The root are soaked overnight and the alcohol extract of the some is given 20 gm/kg body Wight.</td>
</tr>
<tr>
<td>No.</td>
<td>Plant Name</td>
<td>Part Used</td>
<td>Therapeutic Use</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------</td>
<td>-------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>Moringa oleifera Lamk. (Moringaceae)</td>
<td>Munga</td>
<td>Fruit Tree, The juice is recommended the rice daily for 7 days.</td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>Momordica charantia L. (Cucurbitaceae)</td>
<td>Karela</td>
<td>Fruit Herb, About bitter gourd if eaten daily there will be no chonce of diabetes.</td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Musa paradisiaca L. (Musaceae)</td>
<td>Kola</td>
<td>Fruit Herb, 23 tea spoon full juice of plant is taken daily along with</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>Mentha piperita L. Emend. Huds. (Lamiaceae)</td>
<td>Podina</td>
<td>Fruit Herb, -</td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>Oxalis corniculata L. (Oxalidaceae)</td>
<td>Khatkurla</td>
<td>Wood Herb, -</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>Ougeinia oojenensis (Roxb.) Hochr. (Fabaceae)</td>
<td>Sandan</td>
<td>Seed Tree, -</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>Oryza sativa Linn. (Poaceae)</td>
<td>Dhan</td>
<td>Root Herb, -</td>
<td></td>
</tr>
<tr>
<td>89</td>
<td>Olea europoea (Oleaceae)</td>
<td>Olive Oile</td>
<td>Seed Tree, Powder with milk twice a day for 25 day.</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Phyllanthus emblica L. (Euphorbiaceae)</td>
<td>Amlaki</td>
<td>Fruit Tree, About 3-4 gm. Dry rind powder is taken daily along with a pinch of rock salt.</td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>Psidium guajava L. (Myrtaceae)</td>
<td>Amrud</td>
<td>Fruit Tree, Powder with butter milk twice per day for days.</td>
<td></td>
</tr>
<tr>
<td>92</td>
<td>Protulaca oleracea (Portulaceae)</td>
<td>Golbhaji</td>
<td>Leaves Herb, About 10 mg. fresh plant is boiled in cup of water and the filtered juice is taken twice daily</td>
<td></td>
</tr>
<tr>
<td>93</td>
<td>Punica granatum L. (Punicaceae)</td>
<td>Anar</td>
<td>Pericarp Tree, One fruit daily eaten</td>
<td></td>
</tr>
<tr>
<td>94</td>
<td>Pterocorpus Marsupium Roxb. (Fabaceae)</td>
<td>Bijasal</td>
<td>Bark Tree, Aqueous extract of the hard wood is given for diabetes about 1 gm. Past is taken.</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td><em>Pandanus odoratissimus</em> L.F. (Pandanaceae)</td>
<td>Kevda</td>
<td>Root</td>
<td>Tree</td>
</tr>
<tr>
<td>96</td>
<td><em>Phascolus vulgaris</em> (Fabaceae)</td>
<td>French bean</td>
<td>Seed</td>
<td>Climber</td>
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<tr>
<td>97</td>
<td><em>Picrorhiza kurroa</em> Pennell. (Scrophulariaceae)</td>
<td>Kutki</td>
<td>Rhizome</td>
<td>Herb</td>
</tr>
<tr>
<td>98</td>
<td><em>Rhizophora apiculate</em> (Rhizophoraceae)</td>
<td>Garjan</td>
<td>Leaves</td>
<td>Herb</td>
</tr>
<tr>
<td>99</td>
<td><em>Ruta graveolens</em> (Rutaceae)</td>
<td>Aru</td>
<td>Leaves</td>
<td>Herb</td>
</tr>
<tr>
<td>100</td>
<td><em>Rosa rugosa</em> thunb. (Rosaceae)</td>
<td>Japanese rose</td>
<td>Flower</td>
<td>Shrub</td>
</tr>
<tr>
<td>101</td>
<td><em>Rubia cordifolia</em> L. (Rubiaceae)</td>
<td>Majith</td>
<td>Root</td>
<td>Herb</td>
</tr>
<tr>
<td>102</td>
<td><em>Santalum album</em> L. (Santalaceae)</td>
<td>Swet chandan</td>
<td>Stem</td>
<td>Tree</td>
</tr>
<tr>
<td>103</td>
<td><em>Shorea rubusta</em> Gaertn. F. (Dipterocarpaceae)</td>
<td>Sal</td>
<td>Leaves</td>
<td>Tree</td>
</tr>
<tr>
<td>104</td>
<td><em>Stevia rubbendian</em> L. (Astraceae)</td>
<td>Sweet plant</td>
<td>Leaf</td>
<td>Herb</td>
</tr>
<tr>
<td>105</td>
<td><em>Syzgium jambos</em> L. (Myrtaceae)</td>
<td>Jamun</td>
<td>Seed</td>
<td>Tree</td>
</tr>
<tr>
<td></td>
<td>Scientific Name</td>
<td>Common Name</td>
<td>Part Used</td>
<td>Plant Type</td>
</tr>
<tr>
<td>---</td>
<td>----------------</td>
<td>-------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>106</td>
<td><em>Strychnos potatorum</em> L. F. (Loganiaceae)</td>
<td>Nirmah Seed Tree</td>
<td>Seed</td>
<td>Tree</td>
</tr>
<tr>
<td>107</td>
<td><em>Tectona grandis</em> L.F. (Verbenaceae)</td>
<td>Sagvan Seed Tree</td>
<td>Seed</td>
<td>Tree</td>
</tr>
<tr>
<td>108</td>
<td><em>Terminalia arjuna</em> (Roxb. ex. DC.)</td>
<td>Arjun Stem bark Tree</td>
<td>Stem bark</td>
<td>Tree</td>
</tr>
<tr>
<td>109</td>
<td><em>Terminalia catappa</em> L. (Combretaceae)</td>
<td>Deshir badam Fruit Tree</td>
<td>Fruit</td>
<td>Tree</td>
</tr>
<tr>
<td>110</td>
<td><em>Tragia involucrata</em> L. (Euphorbiaceae)</td>
<td>Barhan Root Herb</td>
<td>Root</td>
<td>Herb</td>
</tr>
<tr>
<td>111</td>
<td><em>Tragopgon pratensis</em> (Asteraceae)</td>
<td>Goat's beard Root Herb</td>
<td>Root</td>
<td>Herb</td>
</tr>
<tr>
<td>112</td>
<td><em>Trigonella corniculata</em> (L.) (Papilioaceae)</td>
<td>Methi Seed Herb</td>
<td>Seed</td>
<td>Herb</td>
</tr>
<tr>
<td>113</td>
<td><em>Vaccinium myrtillus</em> L. (Vacciniaceae)</td>
<td>Bilber Fruit Shrub</td>
<td>Fruit</td>
<td>Shrub</td>
</tr>
<tr>
<td>114</td>
<td><em>Withania somnifera</em> (L.) Dunal (Solanaceae)</td>
<td>Aswagandh Root Shrub</td>
<td>Root</td>
<td>Shrub</td>
</tr>
<tr>
<td>115</td>
<td><em>Zanthoxytum or matium DC.</em> (Rutaceae)</td>
<td>Tejphal Fruit Shrub</td>
<td>Fruit</td>
<td>Shrub</td>
</tr>
<tr>
<td>116</td>
<td><em>Zingiber zerumbet</em> Rose. ex. Sm. (Zingiberaceae)</td>
<td>Narkachur Rhizome Herb</td>
<td>Rhizome</td>
<td>Herb</td>
</tr>
</tbody>
</table>
2.8. Pharmacological Literature

2.8.1 Gymnema sylvestre

- R Karthic et al (2012) studies the antidiabetic effects of suspension cell extract of *Gymnema sylvestre* (*G. sylvestre*) along with field grown and wild plants. The effect of ethanolic extracts of the in vitro grown suspension cells of *G. sylvestre* along with field grown and wild plant leaves of *G. sylvestre* was tested on alloxan induced diabetic rats. It can be concluded that *G. sylvestre* suspension cell extract show excellent antidiabetic potential against alloxan induced diabetic albino male rats

- Ahmed AB et al (2012) describes callus induction and the subsequent batch culture optimization and GA quantification determined by linearity, precision, accuracy, and recovery. Evaluation and isolation of GA from the calluses derived from different plant parts. Factors such as light, temperature, sucrose, and photoperiod were studied to observe their effect on GA production. The results showed that physical and chemical factors greatly influence the production of GA in callus cultures of *G. sylvestre*

- Kumar V et al (2012) study was done to assess the effect of *Gymnema sylvestre* extract (GSE) in the high fat diet (HFD)-induced cellular obesity and cardiac damage in Wistar rats. Oral feeding of HFD (20 g/day) for a period of 28 days resulted in a significant increase in body mass index, organ weights, visceral fat pad weight, cardiac caspase-3, cardiac DNA laddering (indicating apoptotic inter-nucleosomal DNA fragment), and lipid peroxide levels of cardiac tissues of rats. Further, mean arterial blood pressure, heart rate, serum leptin, insulin, LDH, LDL-C, total cholesterol, triglycerides, and apolipoprotein-B levels were enhanced significantly,
whereas serum HDL-C, apolipoprotein-A1 levels, and cardiac Na(+) K(+) ATPase, antioxidant enzymes levels were significantly decreased. Furthermore, treatment with standardized ethanolic GSE (200 m/kg/p.o.) for a period of 28 days resulted in significant reversal of above mentioned changes in the obese Wistar rats. The present study has demonstrated the significant antiobesity potential of GSE in murine model of obesity.

- Chandel HS et al. (2011) standardized of eight herbal anti-diabetic drugs-Momordica charantia (seeds), Syzigium cumini (seeds), Trigonella foenum (seeds), Azadirachta indica (leaves), Emblica officinalis (fruits), Curcuma longa (rhizomes), Gymnema sylvestre (leaves), Pterocarpus marsupium (heart-wood) individually and in polyherbal marketed samples of Baidyanath Madhumehari Churna. The limits obtained from the different physicochemical parameters of the individual eight herbal drugs and the marketed formulations could be used as reference standard for standardization of the anti-diabetic drugs in a quality control laboratory.
2.8.2 *Eugenia jambolana*

- Kosaraju J, Dubala A et al (2013) studied on *Pterocarpus marsupium* (PM) (Leguminosae), *Eugenia jambolana* (EJ) (Myrtaceae) and *Gymnema sylvestre* (GS) (Asclepiadaceae) are the most important medicinal plants in the Indian system of traditional medicine for the treatment of hyperglycemia. Dipeptidyl peptidase-4 (DPP-4) inhibitors are the emerging class of anti-diabetic agents. the extracts may have potent DPP-4 inhibitory action, and their hypoglycemic action attributed through an increase in plasma active GLP-1 levels.

- Rizvi SI, Mishra N (2013) Plants have always been a source of drugs for humans since time immemorial. The Indian traditional system of medicine is replete with the use of plants for the management of diabetic conditions. According to the World Health Organization, up to 90% of population in developing countries use plants and its products as traditional medicine for primary health care. There are about 800 plants which have been reported to show antidiabetic potential. The present review is aimed at providing in-depth information about the antidiabetic potential and bioactive compounds present in Ficus religiosa, Pterocarpus marsupium, Gymnema sylvestre, Allium sativum, Eugenia jambolana, Momordica charantia, and Trigonella foenum-graecum. The review provides a starting point for future studies aimed at isolation, purification, and characterization of bioactive antidiabetic compounds present in these plants.

- Khan V, Najmi AK, et al (2012) review focuses on the various plants that have been reported to be effective in diabetes. A record of various medicinal plants with their established antidiabetic and other health benefits has been reported. These include
Allium sativa, Eugenia jambolana, Panax ginseng, Gymnema sylvestre, Momrodica charantia, Ocimum sanctum, Phyllanthus amarus, Pterocarpus marsupium, Trigonella foenum graecum and Tinospora cordifolia. All of them have shown a certain degree of antidiabetic activity by different mechanisms of action.

- Anwesa Bag et al. (2012) studied that possible in vitro antibacterial potential of extracts of Eugenia jambolana seeds against multidrug-resistant human bacterial pathogens by used Agar well diffusion and microbroth dilution assay methods. The results provide justification for the use of E. jambolana in folk medicine to treat various infectious.

- Baliga MS (2011) Studied on cancer is still a major cause of death. Estimates are that it will surpass cardiovascular disease as the leading cause of death, with higher incidences in the developing countries that have minimal resources. Chemotherapy and radiotherapy, the two most commonly used treatment modalities, are associated with untoward side effects. This has necessitated the search for alternatives that are effective, non-toxic and easily affordable for patients and traditional medicinal plants are an ideal source. Eugenia jambolana Lam., commonly known as black plum or 'jamun' is an important medicinal plant in various traditional systems of medicine. It is effective in the treatment of diabetes mellitus, inflammation, ulcers and diarrhea and preclinical studies have also shown it to possess antineoplastic, chemopreventive and radioprotective properties. Here, for the first time, the effects of jamun in treatment and prevention of cancer, and the mechanisms responsible for these effects are appraised. Additionally the drawbacks in existing knowledge are also stressed to
emphasize the possible avenues that need to be investigated, so that maximum effects on both prevention and cure can be attained.

- Sharma Suman Bala et al. (2006) studied The oral antihyperglycemic effect of the water and ethanolic extracts of the fruit-pulp of Eugenia jambolana (EJ) was investigated in alloxan-induced diabetic with fasting blood glucose The results showed that in vitro studies with pancreatic islets showed that the insulin release more than that in untreated diabetic rabbits.
2.8.3 Momordica charantia

- Chhabra G, Dixit A (2013) Momordica charantia is a well known medicinal plant used in the traditional medicinal system for the treatment of various diseases including diabetes mellitus. Recently, a novel protein termed as ADMc1 from the seed extract of M. charantia has been identified and isolated showing significant antihyperglycemic activity in type 1 diabetic rats in which diabetes was induced. Homology modeling approach was used to generate a high quality protein 3D structure for the amino acid sequence of the ADMc1 protein in this study. The comparative assessment of secondary structures revealed ADMc1 as an all-alpha helix protein with random coils. Tertiary structure predicted on the template structure of Napin of B. Napus (PDB ID: 1SM7) with which the ADMc1 showed significant sequence similarity, was validated using protein structure validation tools like PROCHECK, WHAT_CHECK, VERIFY3D and ProSA. Arrangement of disulfide bridges formed by cysteine residues were predicted by the Dianna 1.1 server. The presence of multiple disulfide bond confers the stable nature of the ADMc1 protein. Further, the biological activity of the ADMc1 was assessed in non-obese diabetic (NOD) mice which are spontaneous model of type 1 diabetes. Significant reduction in the blood glucose levels of NOD mice was observed up to 8 h post administration of the rADMc1 protein. Overall, the structural characterizations with antihyperglycemic activity of this seed protein of Momordica charantia demonstrate its potential as an antidiabetic agent.

- Gauttam VK, Kalia AN (2013) study was designed to develop a phospholipids encapsulated polyherbal anti-diabetic formulation. In the present study, polyherbal formulation comprises of lyophilized hydro-alcoholic (50% v/v) extracts of
Momordica charantia, Trigonella foenum-graecum and Withania somnifera 2:2:1, respectively, named HA, optimized based on oral glucose tolerance test model in normal Wistar rats. The optimized formulation (HA) entrapped in the phosphatidylcholine and cholesterol (8:2) vesicle system is named HA lipids (HAL). The vesicles were characterized for shape, morphology, entrapment efficiency, polar-dispersity index and release profile in the gastric pH. The antidiabetic potential of HA, marketed polyherbal formulation (D-fit) and HAL was compared in streptozotocin-induced diabetic rat model of 21 days study. The parameters evaluated were behavioral changes, body weight, serum glucose level, lipid profile and oxidative stress. The antidiabetic potential of HA (1000 mg/kg) was at par with the D-fit (1000 mg/kg). However, the potential was enhanced by phospholipids encapsulation; as HAL (500 mg/kg) has shown more significant (P < 0.05) potential in comparison to HA (1000 mg/kg) and at par with metformin (500 mg/kg).

- Samsul Alam et.al (2009) studied the effect of standardized methanolic extract of Momordica charantia L. fruits on gastric and duodenal ulcers. The effect was evaluated in acetic acid induced chronic gastric ulcer, pylorus ligation induced gastric ulcer, ethanol induced gastric ulcer, stress induced gastric ulcer, indomethacin induced gastric ulcer and cysteamine induced duodenal ulcer model. The extract was administered orally at two different doses of 100 mg/kg and 500 mg/kg. The methanolic extract of Momordica charantia L. fruit increases healing of gastric ulcer and also prevents development.
Raman et al. (1996) studied the fruit, seeds and aerial parts of Momordica charantia Linn. (Cucurbitaceae) via oral administration of the fruit juice or seed powder causes a reduction in fasting blood glucose and improves glucose tolerance in normal and diabetic animals and in humans.
2.8.4 *Emblica officinalis* Gaertn

- Thilakchand KR, Mathai RT et al (2013) studied on Hepatoprotective properties of Emblica officinalis Gaertn or Phyllanthus emblica Linn, commonly known as the Indian gooseberry in English or amla in Hindi, is one of the most important medicinal and dietary plants in the Indian subcontinent. The fruits are of dietary and medicinal use and have wide applications in both traditional and folk systems of medicine. Scientific studies have shown amla to be effective in preventing/ameliorating the toxic effects of hepatotoxic agents like ethanol, paracetamol, carbon tetrachloride, heavy metals, ochratoxins, hexachlorocyclohexane, antitubercular drugs and hepatotoxicity resulting from iron overload. Amla is also reported to impart beneficial effects on liver function and to mitigate hyperlipidemia and metabolic syndrome. Amla possesses protective effects against chemical-induced hepatocarcinogenesis in animal models of study. Additionally, the phytochemicals quercetin, gallic acid, corilagin and ellagic acid are also reported to protect against the cytotoxic effects of paracetamol, microcystins, galactosamine and lipopolysaccharide. The hepatoprotective actions of amla appear to be mediated by its free radical scavenging, antioxidant, anti-inflammatory and modulation of the xenobiotic detoxification process and lipid metabolism.

- Pradyumna Rao T et al (2013) the present study evaluated the anti-inflammatory and anticoagulant properties of amla fruit extract. The amla fruit extract potentially and significantly reduced lipopolysaccharide (LPS)-induced tissue factor expression and von Willebrand factor release in human umbilical vein endothelial cells (HUVEC) in vitro at clinically relevant concentrations (1-100 µg/ml). In a leucocyte adhesion
model of inflammation, it also significantly decreased LPS-induced adhesion of human monocytic cells (THP-1) to the HUVEC, as well as reduced the expression of endothelial-leucocyte adhesion molecule-1 (E-selectin) in the target cells. In addition, the in vivo anti-inflammatory effects were evaluated in a LPS-induced endotoxaemia rat model. Oral administration of the amla fruit extract (50 mg/kg body weight) significantly decreased the concentrations of pro-inflammatory cytokines, TNF-α and IL-6 in serum. These results suggest that amla fruit extract may be an effective anticoagulant and anti-inflammatory agent.

- Parminder Nain et al.(2012) studied the all parts of Emblica officinalis Gaertn plant including the fruit, seed, leaves, root, bark and flowers are used in various herbal preparations for the treatment of diabetes mellitus in streptozotocin induced diabetic rats. The results showed the hydro methanolic extract of leaves of Emblica officinals Gaertn rapid protective effects against lipid peroxidation by scavenging of free radicals and reducing the risk of diabetic complications.

- P. Scartezzini et.al (2006) studied the determination of ascorbic acid in Emblica fruit and particularly in Emblica fruit by using A reliable and feasible HPLC method and The antioxidant effects have also been evaluated in comparison to the real levels of Vitamin C the resulted data showed that the Emblica fruit contains ascorbic acid (0.40%, w/w), It has also been found that Vitamin C accounts for approximately 45–70% of the antioxidant activity.
2.8.5 *Curcuma longa*

- Lekshmi PC, Arimboor R, et al. (2012) In this study, turmerin, a water-soluble peptide in turmeric rhizomes, was evaluated for its inhibitory potential against glucosidase and its antioxidant (AO) capacity. Turmerin inhibited $\alpha$-amylase and $\alpha$-glucosidase activities with IC values 31 and 192 $\mu$g mL$^{-1}$, respectively. Under the experimental conditions, those values for a standard glucosidase inhibitor, acarbose, were 81 and 296 $\mu$g mL$^{-1}$, respectively. The AO capacity of turmerin was evaluated using in vitro assay systems. Turmerin showed good DPPH (IC = 29 $\mu$g mL$^{-1}$) and superoxide (IC = 48 $\mu$g mL$^{-1}$) and moderate ABTS (IC = 83 $\mu$g mL$^{-1}$) radical scavenging and Fe(II) chelation (IC = 101 $\mu$g mL$^{-1}$) capacities. The inhibitory potential showed by turmerin against enzymes linked to type 2 diabetes, as well as its moderate AO capacity, could rationalise the traditional usage of turmeric rhizome preparations against diabetes.

- Rajasekaran SA (2011) Curcumin, also known as diferuloylmethane, is derived from the plant *Curcuma longa* and is the active ingredient of the spice turmeric. The therapeutic activities of curcumin for a wide variety of diseases such as diabetes, allergies, arthritis and other chronic and inflammatory diseases have been known for a long time. More recently, curcumin's therapeutic potential for preventing and treating various cancers is being recognized. As curcumin's therapeutic promise is being explored more systematically in various diseases, it has become clear that, due to its increased bioavailability in the gastrointestinal tract, curcumin may be particularly suited to be developed to treat gastrointestinal diseases. This review summarizes some of the current literature of curcumin's anti-inflammatory, anti-oxidant and anti-cancer potential in inflammatory bowel diseases, hepatic fibrosis and gastrointestinal cancers.
Chandel HS et al (2011) standardized of eight herbal anti-diabetic drugs-Momordica charantia (seeds), Syzigium cumini (seeds), Trigonella foenum (seeds), Azadirachta indica (leaves), Emblica offi cinalis (fruits), Curcuma longa (rhizomes), Gymnema sylvestre (leaves), Pterocarpus marsupium (heart-wood) individually and in polyherbal marketed samples of Baidyanath Madhumehari Churna. The limits obtained from the different physicochemical parameters of the individual eight herbal drugs and the marketed formulations could be used as reference standard for standardization of the anti-diabetic drugs in a quality control laboratory.

Wickenberg J et al (2010) The purpose of the study is to study the effect of C. longa on postprandial plasma glucose, insulin levels and glycemic index (GI) in healthy subjects. The ingestion of 6 g C. longa had no significant effect on the glucose response. The change in insulin was significantly higher 30 min (P = 0.03) and 60 min (P = 0.041) after the OGTT including C. longa. The insulin AUCs were also significantly higher after the ingestion of C. longa, 15 (P = 0.048), 30 (P = 0.035), 90 (P = 0.03), and 120 (P = 0.02) minutes after the OGTT. The ingestion of 6 g C. longa increased postprandial serum insulin levels, but did not seem to affect plasma glucose levels or GI, in healthy subjects. The results indicate that C. longa may have an effect on insulin secretion.

Ramsewak R.S et al. (2000) studied the Curcumin I, curcumin II (monodemethoxycurcumin) and curcumin III (bisdemethoxycurcumin) from Curcuma longa were assayed for their cytotoxicity, antioxidant and anti-inflammatory activities. These compounds showed activity against leukemia, colon, CNS, melanoma, renal, and breast cancer cell lines. Curcums I-III also showed good inhibition of the COX-II enzyme.
2.9 Formulation of dosage form from Medicinal Plants

- Sati et al., (2011) studied formulation and evaluation of herbal tablets containing *Ervatamia heyneana* extract for analgesic and anti-inflammatory activity. From the time immemorial, man has been depending on plants medicine. Algesia and inflammation are one of the most common problems affecting a large proportion of the world’s population. Algesia and inflammation can be treated by various herbal drugs. The purpose of the present work was to formulate the tablets from the aqueous root extract of *Ervatamia heyneana*. In this work the dried powder of plant extract was used. The tablets were prepared by direct compression method by using various excipients viz., Lactose, MCC PH 102, Sodium starch glycolate, dibasic calcium phosphate, talc, aerosil and magnesium stearate. The pre compression parameters of powder blend were evaluated for flow properties and compressibility, which were found to be good. The tablets were evaluated for the post compression parameters like weight variation, friability, hardness and disintegration time. Finally the solid pharmaceutical dosage formulation was evaluated for its analgesic and anti-inflammatory activity and it was found to be statically significant.

- Kaushik et al. (2011) studied formulation and evaluation of herbal antidiabetic tablet. Phytomedicines based on principles of Ayurveda are need of the hour and is more feasible than allopathic drugs which is not only more expensive in terms of “leads” but is also associated with many unwanted effects. Ethnopharmacological usage and the literature review revealed that the *Alangium salvifolium* seeds (Ankola) have significant antidiabetic activity. After the detailed study of powder of ethanolic extract of seeds of *Alangium salvifolium* Linn., a formulation using the plant material was
prepared, to make the formulation more acceptable and justified for diabetics, an
excipient having nutraceutical value like soy was also incorporated, the formulation
was evaluated and standardized as per the pharmacopoeial standards. The results of
preformulation studies revealed that all the values were within acceptable limit.
Formulation showed appreciable hardness characteristics (3.25±0.57), which
facilitates its fast disintegration. The friability (0.29±0.03) of formulation indicated
that the tablets were mechanically stable. As the average weight of tablets was 340
mg, the acceptable weight variation range is ±7%. Hence the entire formulated tablet
passed the weight variation test. The disintegration time of formulations was more
than 1 minute. Thus the claims made by the traditional Indian systems of medicine
regarding the use of this plant in the treatment of diabetes stands confirmed. The final
conclusion drawn from the above mentioned data is that the possible use of these
economical and relatively non toxic, non-hazardous natural remedies of plant origin
may further be explored as they are devoid of major side effects associated with
synthetic agents.

- Puri et al. (2011) studied formulation and evaluation of anthelmintic polyherbal
tablets. From time immemorial, man has been depending on plants as medicine.
Helminthes infections are among the most common infections in man, affecting a
large proportion of the world's population. These helminthic diseases can be treated by
various herbal drugs. The purpose of the present work was to formulate antihelminthic
tablets. In this work, a spray dried-powder was used, which was obtained from the
extract of different part of seven plants that were used in helminthic disease. The
different tablets were prepared by using different types of disintegrating agents and
various excipients. All parameters related to physicochemical property, trace metal and microbial examination of the spray-dried powder showed that these were within limits and could be used for the tablet formulation. The granules of the spray-dried powder were prepared by a wet granulation technique using isopropyl alcohol. The blends were evaluated for flow properties and for compressibility, which were found to be good. The tablets were prepared using a single rotatory punching machine, in which the punch size was 11 mm×8 mm, and formulated caplet-type tablets. These tablets were evaluated for the colour, odor, thickness and diameter, with visual inspection for any defects, weight variation, hardness, friability and in vitro disintegration time.

Ghiware et al, (2010) investigated design, development and evaluation of oral herbal formulations of *Piper nigrum* and *Nyctanthes arbortristis*. In the present investigation, three orally administrable dosage forms of fruits of *Piper nigrum* (Maricha) and leaves of *Nyctanthes arbortristis* (Parijataka), in combination, were developed. Tablet form of drugs from solid dosage form and two formulations from liquid class were designed and developed. By considering difficulty of solubility of herbal drugs in a vehicle, in one of the liquid class, decoction form of drugs in specific vehicle was used. This form of drugs hereafter considered as liquid oral dosage form of drugs. To prepare a liquid form with suspended particles of drugs, suspension form was also designed. Formulated dosage forms then subjected to evaluation of production quality by different methods stated as per official compendia. Such evaluation has unique position in development of new formulations.
Tavakoli et al. (2008) studied formulation and evaluation of a new herbal tablet from strawberry and grape leaves. Liver is the largest organ of the body, with several major functions. Increased consumption of chemicals (e.g. alcohol, bleach, preservatives, colorings, etc) and pharmaceuticals lead to a large number of liver diseases. Symptoms of liver malfunction include sudden exhaustion, bad taste in the mouth, loss of appetite, distaste foods, irritability or a general feeling of unhealthiness. There are a few herbal products from *Fragaria vesca* and *Vitis vinifera* as chewable tablets form in the market that are used as metabolic stimulator and as a treatment for all chronic inflammatory and degenerative liver conditions. The leaves of grape and wild strawberry were collected, identified and dried. The content of anthocyanins present in the powdered leaves was measured based on a spectrophotometric differential pH method. To prepare chewable tablet (HepatoHeal), the same amount of powdered leaves of two plants (40 mg) was mixed to filler (mannitol or lactose) and granulated using wet granulation method. The resultant tablets were evaluated for hardness, friability, disintegration time, drug content uniformity, drug release test and organoleptic properties. The assay showed that the content of anthocyanin in grape and strawberry leaves were 0.082(w/w) % and 0.039(w/w) %, respectively. The mean weight, friability, hardness, and disintegration time of selected formulation were 262 mg, 0.23%, 59.7 N and 22.6 min, respectively. The content of active ingredient (based on anthocyanin) was 44.8 mg and the content uniformity of the selected tablet was 42.8 mg. Percent of the drug released after 30 and 60 min was 76 % and 97 % respectively. The selected formulation of HepatoHeal tablet has acceptable
physicochemical features and may be considered as a herbal medication for some chronic inflammatory and degenerative liver disorders.

- Misra et al. (2011) studied formulation development and evaluation of herbal tablet containing methanolic extract of *Butea frondosa*. Medicinal plants have curative properties due to the presence of various complex chemical substance of different composition, which are found as secondary plant metabolites in one or more parts of these plants. *Butea frondosa* belongs to family Fabaceae is a deciduous tree indigenous to India and widely used in different disease conditions. The present paper deals with formulation and evaluation of herbal tablets prepared from methanol extract of the selected plant. A solid pharmaceutical dosage formulation using a novel dry plant extract (stem barks) using various excipients viz., sprays dried lactose, starch 1500, aerosil-200 and magnesium stearate by direct compression method. The micromeritic properties were determined for all the physical mixtures, the results of angle of repose, carr’s index and hausner ratio indicated that the powder mixtures possess good flow properties and good packing ability. The physical properties of tablet were determined and all the samples of the test product complied with the official requirements of uniformity of weight. The drug content was found to be close to 100% in all formulations. The absorption curve of *Butea frondosa* methanolic extract showed characteristic absorption maximum at 274 nm in 0.1N HCl. The drug obeyed Beer’s law in the concentration range of 10mcg/ml to 200mcg/ml, and it was found to be linear with r2 = 0.999, regression equation Y = 0.017x + 0.003. It was found that the release rate of drug increased as the percentage of starch 1500 was increased from 10 mg to 30mg. As the concentration of starch 1500 increased the
release rate increased from 45.25% to 98.69% (BFT4) in 6 hours by increasing the concentration of starch 1500. The drug interaction FT-IR studies indicated that there was no chemical interaction between the drug and the polymers used in tablet formulations. The optimized formulation BFT4 of the drug was subjected to accelerated stability studies and the results were reproducible, even on tablets that had been stored for about 3 months at 250C/60% RH, 300C/60% RH and 400C/75% RH.

- Gupta and Gahlot (2012) studied formulation and evaluation of herbal antidemential tablets. Herbs and their extracts/fractions are used for the treatment of different diseases and few as a memory enhancing agent. Different plants have been used as a memory enhancer in the folkloric medicine. Present study was undertaken to prepare a combined herbal formulation of the extracts of dried root powder of *Plumbago zeylanica* and powdered seeds of *Silybum marianum* for the treatment of dementia. HPTLC quantification characterization and identification of the herbal extracts of *P. zeylanica* and *S. marianum*, was performed using the standard marker compound, plumbagin and silibinin respectively of these drugs. Through the acute oral toxicity studies the dose of the extract in the formulation and a LD50 and ED50 profile of the drug combination were established. Design & development of tablet using two doses of the extract was done and evaluation was carried out on various standard parameters of formulation including accelerated stability tests, which was in turn found satisfactory and within the specified limits. Preliminary pharmacological screening of dementia was performed on formulated tablets using EPM (Elevated plus maze) and MWM (Morris water maze), two of the animal models of dementia. Here, Piracetam (400mg/kg p.o) a nootropic agent was employed as a standard drug. Sodium Nitrite
(75mg/kg i.p) was used to induce amnesia in young experimental model, and which is comparable with that of the age related amnesia in old rats. The results indicate that administration of tablets produce significant dose dependant improvement of memory and were almost similar with that of standard drug Piracetam. In the present study antidemential activity of the combined herbal formulation of *P. zeylanica* and *S. marianum* and a few standardization parameters were tried to established, which can be further analysed and proceeded to prepare an effective antidemential formulation.

- Manjula *et al.*, (2012) investigated design development and evaluation of herbal tablets containing *Andrographis paniculata* and *Phyllanthus amarus*. The formulated tablets were recommended as hepatoprotective agents. It contains *Andrographis paniculata* and *Phyllanthus amarus*. The present work is based on the standardization of individual ingredients and formulation of the tablet with improved formulation parameters. Physicochemical parameters were also checked for individual crude drugs. Granulation was done by using PVP and gelatin as binder by wet granulation technique. The pre formulation parameters like bulk density, tap density, carr’s index, hausner’s ratio and angle of repose were checked for laboratory granules. The tablets were evaluated for, weight variation, thickness, hardness, friability and disintegration time. The designed formulation was in conformity to the properties evaluated for the tablets and further preclinical studies have to be done to test its efficacy.

- Shirwaikar *et al.*, (2005) studied formulation and evaluation of *Boswella serrata* tablets. An attempt was made to formulate *Boswellia serrata* extract as a conventional tablet using various excipients in different proportions. Herbal raw materials and finished herbal medicinal products specifications were set according to committee for
proprietary medicinal products. Eleven such formulations were prepared and evaluated for physical parameters such as thickness, hardness, friability, weight variation, drug content, disintegration time and drug release pattern. The formulations prepared with different proportions of disodium hydrogen phosphate in 10, 15 and 20% as solubilising agent showed maximum drug release. The formulated tablets had better appearance and drug release properties.

- Kashikar and Patkar (2011) studied formulation and evaluation of taste mask chewable tablet herbal for cough remedy. Attempt was made to formulate the taste mask chewable tablets for cough remedies using various herbal ingredients. Further the formulation was evaluated for various parameters and found to be within the limits.

- El-hassan et al., (2012) investigated design, formulation and evaluation of Senna effervescent tablets. Cassia leaves and pods extracts has been used in traditional or herbal medicine since ancient times. The pods and leaves contain anthraquinone glycosides that have a significant laxative effect. In this study anthraquinone was extracted from Senna (Cassia acutifolia Delile) pods and the active constituents were checked to confirm the presence of both Anthraquinone compounds (sennosoides A and B). Effervescent tablets were formulated using the senna extract as the active ingredient in addition to other tabletting constituents. The formulated tablets were then subjected to the known official monographs requirements like: resistance to crushing (hardness test), weight variation, disintegration time/ effervescent time, friability test, content uniformity test and pH. The results obtained were: 7.4 kg / cm², 10%, 59.01s, 0.74%), 97.30%) and 5.4 for resistance to crushing, weight variation, disintegration time, friability test, content uniformity test and pH respectively. The values obtained
indicate the effervescent comply with the pharmaceutical standards set by British Pharmacopoeia (BP) and United States Pharmacopoeia (USP). These tablets can be used as an alternative source of laxative medicine in Sudan due to the abundance of Cassia acutifolia as a wild plant.

- Chandira et al., (2012) studied formulation and pharmacological evaluation of bark extract of Albizia odoratissima (L.F) Benth. Albizia odoratissima has been used in folk medicines for the treatment of Diabetes. To substantiate this claim the present studies have been undertaken in order to evaluate the Antihyperglycemic activity of alcoholic extract of bark of Albizia odoratissima (AIEAO) and its aqueous extract of bark of Albizia odoratissima (AqEAO). These two fractions was assessed for hypoglycaemic activity on alloxan induced (150mg/kg) swiss albino rats. The LD50 of the extracts were found to be 1000mg/kg. The extract powder are formulated as conventional dosage form by direct compression technique using polymer HPMC K4M and CMC Sodium in the concentration range of 5%. The tablets are evaluated with alloxan induced diabetic rats. The antidiabetic activity was compared with that of the reference drug glibenclamide (5mg/kg). The AIEAO fraction produces the significant reduction (P<0.001) in BGL (Blood Glucose Level) after single administration (Dose: 100mg/kg, Route: Oral) for 10 days prolonged treatment. The BGL was measured using Glucometer on the 0th, 3rd and 10th day. The AIEAO shows the significant hypoglycaemic activity compared to that of the standard drug.

- Komperlla (2004) studied the formulation and evaluation of rapid release tablets manufactured from Artemisia afra plant material. Infusions, decoctions, alcoholic preparations (i.e. Wilde als brandy) and other dosage forms of Artemisia afra are
frequently used in South African traditional medicine. Generally when these preparations are made without applying good manufacturing practices they do not meet microbial quality control standards, safety and toxicity criteria and encourage poor patient compliance. To overcome the aforementioned disadvantages of traditional dosage forms a solid dosage form i.e. a tablet might be recommended. The first objective of this study was to formulate and manufacture a rapid release tablet dosage of *Artemisia afra* that would contain an amount of plant material equivalent to that found in its traditional liquid dosage forms and that would meet conventional pharmaceutical standards. The second objective was to conduct a pilot study to obtain a preliminary profile of the bioavailability of select flavonoids (luteolin) present in both the tablet and traditional liquid preparation of *Artemisia afra* in human. A freeze-dried aqueous extract of *Artemisia afra* leaf was prepared and the physical properties of the extract powder were characterised in a preformulation study. The information obtained was then used to select and evaluate, in a formulation development study, several excipients for their appropriateness for formulation development and manufacture of *Artemisia afra* tablets by direct compression. Tablets containing 300mg of plant material were then manufactured and tested for uniformity of mass and content, disintegration, dissolution and microbial contamination using British Pharmacopoeia methods. The stability of the manufactured tablets under the conditions of 40°C & 75% relative humidity (RH), 25°C & room humidity and 5°C & 0% RH were also evaluated. Finally, the bioavailability of the flavonoids (in particular luteolin) in the tablet formulation was evaluated in an open-label, single site, single dose 2 X 2 crossover design study in 2 healthy adult human volunteers, each of whom
received the test plant material (in form of a tea or tablets) on 2 separate occasions, 21 days apart. Blood samples (4.5ml) were collected at 0, 15, 30, 45, 60, 180 & 300 minutes and assayed for luteolin using an HPLC assay. The results of the preformulation study indicated that the freeze-dried plant extract powder had acceptable flowability, compressibility and microbial quality, but was highly hygroscopic. Consequently, the manufacture of the tablets could only be done under controlled humidity conditions of below 40% RH. The manufactured tablets containing the plant extract and excipients such as Tabletose®, Emcompress®, etc. however complied with all the official specifications. They contained 393 ± 60.82 µg luteolin and 411 ± 40.49 µg quercetin per tablet and levels that were within the B.P. 1999 limits i.e. between 85% and 115% of the average content of manufactured batch. The tablets also had a disintegration time of 10 ± 0.4 minutes (n=12), a dissolution rate of 81.01 ± 9.18% at 45 minutes (n=6) and passed the microbial quality tests of the 1999 British Pharmacopoeia. In the stability tests the physical appearance of the tablets however deteriorated badly and they did not pass the stability test when stored under conditions of 40oC & 75%RH and 25oC & room humidity. Finally, no detectable amounts of luteolin and other flavonoids could be detected in the blood of the 2 subjects (volunteers) after they had ingested the tea or the test tablets of Artemisia afra. The results obtained thus confirmed that even though the dried aqueous extract of Artemisia afra leaves was problematically very hygroscopic tablets of suitable pharmaceutical quality could be manufactured from this dried aqueous extracts of Artemisia afra leaves when controlled humidity conditions were used. Furthermore, luteolin and quercetin quantitated by HPLC assay were useful markers to
confirm the content uniformity and to test for the stability of the tablets. However, a preliminary profile of the bioavailability of these markers after the ingestion of the tablets or Artemisia afra tea could not be obtained, most likely because the levels of the luteolin in the tablet and infusion of Artemisia afra ingested were too low to be detected. This compound is thus not suitable as a marker to evaluate the bioavailability of these dosage forms.

- Chandira and Jayakar (2010) studied formulation and evaluation of herbal tablets containing Ipomoea digitata Linn. Extract. Medicinal plants have curative properties due to the presence of various complex chemical substance of different composition, which are found as secondary plant metabolites in one or more parts of these plants. Ipomoea digitata Linn., Convolvulaceae is a annual extensive perennial climber with large ovoid and tuberous roots herb indigenous to India and widely used in the treatments of hypolipodemic, hypogycemic, for debility, to increase secretion of milk, to increases milk, poor digestion, tuberculosis, enlarged liver etc. It was also found to have alterative, aphrodisiac, cholagogue, demulcent, diuretic, rejuvenative actions. The present paper deals with formulation and evaluation of anti-diabetic activity of tablets prepared from aqueous extract of the selected plant. A solid pharmaceutical dosage formulation using a novel dry plant extract (tuberous roots) using various excipients viz., carbopol, ethylcellulose, MCC, dibasic calcium phosphate and PEG-4000 by direct compression was reported to be statically significant as anti-diabetic activity. The present communication also deals with the evaluation of formulated tablets (weight variation, friability, hardness and disintegration time).
Vishwakarma et al., (2011) studied formulation and evaluation of herbal lipstick. Coloring skin particularly skin of face and lips is an ancient practice going back to prehistoric period. In present days the use of such product has increased and choice of shades of color, texture and luster have been changed and become wider. This can be observed from the fact that lipsticks are marked in hundreds of shades of colors to satisfy the demand of women. The present investigation was done to formulate herbal lipstick, since lipsticks are one of the key cosmetics to be used by the women. Attempt was also made to evaluate the formulated herbal lipsticks.