2. REVIEW OF LITERATURE

India has become diabetes-capital of the world, with over 41 million diabetics. The country is also a leader in the prevalence of metabolic syndrome and obesity, with hypertension to join the list soon. Historical evidences suggest that the ancient Indian Physicians were able to stabilize diabetes, obesity and related metabolic syndrome effectively through recommendations, which are not different from those given today the patients, like weight management, suitable diet and exercise. Dietary management in diabetes has always been amongst the key strategies.

The Indian traditional system of medicine prescribed plant therapies for diseases including diabetes mellitus called madhumeha in Sanskrit. Considerable interest for ethno botanical community medications as they are recognized to contain valuable medicinal properties in different parts of the plant and a number of plants have shown varying degree of hypoglycemic and anti-hypoglycemic activity (Grover et al., 2002). Experimentally, Shanmugasundaram et al. (1990) confirmed that the efficacy of traditional preparations claimed to be effective in the treatment of diabetics. Wide array of plant derived compounds with consistent anti diabetic activity has proven their possible use in the treatment of Diabetes Mellitus (Farnsworth, 1998).

Diabetes at present is considered as a heterogeneous entity. Although it is not possible to cure diabetes completely, diabetics can lead a normal life if they follow scrupulously certain do’s and do not’s.

A perusal of literature on the diabetes mellitus shows that a considerable work has been done on different aspects of IDDM and NIDDM patients. The Extensive work done on these aspects are reviewed and given below.

To understand the different aspects of the role of natural food supplementation capsules with special reference to NIDDM patients with obesity, to observe the experimental changes on anthropometric measurements, Biochemical aspects and dietary assessments, the review is done in different sections as follows:

Antimicrobial activity of different Herbal products

Section 2.1: Antimicrobial activity of Herbal supplementation
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The three carbazole alkaloids viz. mahamine, mahanimbicine and mahanimbine and essential oils from the leaves of *Murrya koenigii* were evaluated for the effects on growth of five antibiotic-resistant pathogenic bacteria and three tumor cell lines (MCF-7, P388 and Hela). Mahanimbine and essential oil demonstrated potent dose-dependent antibacterial and cytotoxic effect (<=5.0 microgm/mL). Additionally, significant antitumor activities against MCF-7, Hela and P388 cell lines were also noted (Nagappan et al., 2011 and Kusuma et al., 2011).

Complete inhibition of growth of *L. innocua* was observed with both Solvent-free microwave extraction (SFME) and conventional hydro-distilled oil (HD) essential oils, at 400 and 600 microgm/mL (minimum inhibitory concentration), respectively. The SFME-essential oil at 300 microgm/mL provided 92% inhibition, indicating its potential as a natural antimicrobial agent. (Erkan et al., 2012).

The leaf acetone extract of *M. oleifera* at 5 mg/ml showed antibacterial activities against *E. coli* (ATCC 25922), *E. cloacae* (ATCC 13047), *P. vulgaris* (ATCC 6830), *S. aureus* (ATCC 6538) and *M. kristinae* at 0.5 mg/ml, while reference antibiotics streptomycin Dahot (1998) who reported that *M. oleifera* water extracts had antimicrobial activity against *E. coli, S. aureus* and *B. subtilis*. The difference could be attributed to variation in the environment where the plant is grown.

*Mentha piperita* L. (family labiates genes menthe) is one of the ten most widely used plants in Brazil and is commonly used in the treatment of loss of appetite, common cold
bronchitis, fever, nausea, vomiting (Akdogan et al., 2003), spasmodic responses (Lu et al., 2002) and antimicrobial and antioxidant activities (Romero-Jimenez et al., 2005; Mimica-Dukie et al., 2003). It is also used for culinary purposes. There is evidence that it has a positive effect on glycemia of the laboratory animal (Narendhira and Kauun et al., 2006). However, there are no reports in the literature concerning its effects on the offspring of diabetic animals treated with the respective plant.

*Pseudomonas aureuginosa*. *Enhydrus fluctuans* Lour and *Mentha arvensis* Linn moderate activity (7-10 mm indiameter) against all test organisms except *Bacillus cereus* in case of *Mentha arvensis* Linn. *Salmonella paratyphi* and *Bacillus megaterium* incase of *Enhydrus fluctuans*. *Chenopodium album* Linn and *Glinus oppositifolius* Linn showed comparatively better activity (9-13 mm in diameter) than *Enhydrus fluctuans* Lour and *Mentha arvensis* Linn. The largest zone of inhibition (23 mm in diameter) was recorded against *Bacillus cereus* with the leaf of *Blumea lacera*. Similar antibacterial activity of other plant extracts has been reported previously (Rojas et al., 1992; Bartner and Grein, 1994; Ahmed et al., 1999; Rahman et al., 1998).

Section 2.2: Effect of Herbal supplementation on serum Antioxidant levels

Diabetes mellitus has been shown to be a state of increased free radicals formation. Oxidative stress may increase in diabetes owing to a higher production of reactive oxygen species results into deficiency in anti oxidant defense systems (Bayane and Thorpe, 1999). Thus the anti oxidant actions are keys to preventing or reversing diabetes and its complications (Defronzo, 1999). The protective anti oxidant effects of ethanolic extracts of *Murraya koenigii* leaves (MKL) on the glycemic control in Streptozotocin induced Diabetic animals.

Studies revealed that the decreased activities of hepatic antioxidant enzymes, superoxide dismutase (SOD) and catalase (CAT) found in diabetic rats were restored by the use of oleuropein and hydroxytyrosol, thereby attenuating the oxidative stress associated with diabetes (Jemai et al., 2009 and Cumaoglu et al., 2011).

Gupta and Prakash (2009) reported that the green leafy vegetable the total antioxidant activity was the highest in *Murraya koenigii* (2691 micromol of ascorbic
acid/gm sample) as compared to that of methanol extracts of Amaranthus sp., Centella asiatica and Trigonella.

Studies conducted by (Mitra et al., 2012) indicate that the aqueous extracts of Murrya koenigii leaf confer significant protection to rat cardiac tissue against cadmium-induced oxidative stress probably due to its antioxidant activity. The alterations seen in the levels of lipid peroxidation, reduced glutathione, protein carbonyl content, changes in the activities of cardiac antioxidant and pro-oxidant enzymes, indicate that cadmium-induced tissue damage was the result of oxidative stress. This antioxidant activity of Murrya koenigii could be beneficial to people who are exposed to cadmium either environmentally or occupationally.

Murraya koenigii Leaves extract showed the therapeutic protective nature in diabetes by decreasing oxidative stress and pancreatic beta cell damage (Arulselvan et al., 2007). Different doses of curry leaves (5, 10 and 15 %) were given to normal rats, mild and moderate diabetic rats for seven days the results showed that Murraya koenigii could be useful for management of pre - diabetic state or mild diabetes (Yadav et al., 2002). The carbazole alkaloids (Koenimbine and Kurryam) were isolated from Murraya koenigii seed and oral administration of 50 mg/Kg of Koenimbine and Kurryam exhibited significant anti-diarrheal effects in Castrol oil-induced diarrhea rats (Mandal et al., 2009).

Samarth and Samarth (2009) showed that Mentha piperita leaf extract possesses high amount of phenolic content, flavonoid content and flavonoids, they also observed that this plant has radio protective effects possibly because of the amount of phenolic compounds, and flavonoids due to their antioxidant and radical scavenging activity.

Oxidative stress is implicated in the pathogenesis of type 2 Diabetes Mellitus (DM) by inducing insulin resistance in the peripheral tissues and impairing insulin secretion from pancreatic β-cells (Oberely, 1998; Pabisso and Giugilano 1996., and Cereiello and Motz 2004), the abundant conjugated double bonds of carotenoids can scavenge peroxyl radicals, making them powerful antioxidants that may provide protection against the development of type 2 diabetes. Lycopene has been shown to have male potent antioxidant properties (Mascio et al., 1989).
Many epidemiological studies (Corne et al., 2005 and Polidrictal, 2000) proved that the direct relationship between serum lycopene level, in diabetes and other chronic disease, antioxidant property of tomato lycopene induced oxidative stress in diabetes, so that tomatoes can be recommended as one of the beneficial vegetables for diabetes, tomato helps to indicates its greater biological significance in human antioxidant defense system (Ford et al., 1999).

In diabetic patients, antioxidant protection may be inadequate and plasma levels of some antioxidants including vitamin C and lycopene (Fuller et al., 1996) are frequently low. Supplementation with vitamin E increases isolated LDL resistance to copper ion oxidation in patients with type 2 diabetes (Reaven et al., 1995).

The generation of nitric oxide gives rise to several other reactive species, including peroxynitrite (ONOO–), which is capable of inflicting tissue damage (Verma and kavitha,2007) Lycopene at the concentration of 0.31-10 µM prevented the 3-morpholinosydnonimine stress-induced DNA damage in Chinese hamsters; the protective effect is due to the scavenging of intracellular reactive oxygen and/or nitrogen species, reducing the amounts 47.5% and 42.4% respectively (Muzandu et al.,2006).

Oxidative stress is an important contributor to the risk of chronic diseases. Antioxidants scavenge free radicals, otherwise known as reactive oxygen species (ROS), and prevent the damage they can cause. Free radicals have been associated with pathogenesis of various disorders and diseases such as cancer, cardiovascular disease, osteoporosis, diabetes, and cataracts (Ratnam et al., 2006). In one study, lycopene significantly restored the antioxidant enzymes superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), and glutathione reductase (GR); reduced glutathione (GSH); and decreased levels of the lipid peroxide malondialdehyde (MDA) in hypertensive patients (Bose et al.,2007). In another study, lycopene was found to have a favorable effect in reducing MDA levels and increasing GSH levels in coronary artery disease in postmenopausal women (Misra et al.,2006).

Section 2.3: Hypoglycemic effect of different leaves and cereals
Murraya Koenigii (Curry Leaves) leaves was chosen since it is one of the most widely acclaimed remedies for the treatment of diabetes. Murraya Koenigii leaves were popularly known as curry leaves in India.

The possible mechanism by which the mahanibine decreases blood sugar level may be potentiating of insulin effect either by increasing the pancreatic secretion of insulin from beta cells of islets of langerhans or by increasing the peripheral glucose uptake. The mahanimbine (at a dose 50 and 100 mg/kg I.P) treated diabetic rats showed a significant reduction in both fasting blood sugar levels and serum lipid profiles (TC, TG, LDL and VLDC). Many carbazole alkaloids such as mukonicine, isomurrayazoline, koenoline, isomahanine, murrayanol and mahanimbine were isolated from different parts (leaves, stem, bark and seed) of Marraya koenigii (Mukherjee et al., 1983; Bhattacharya et al., 1982; Fiebig et al., 1985; Pisch et al., 1992 and Roy and Chakra borthy 1974). Mahanimbine is a carbazole alkaloid and present in leaves in murraya koenigii.

Murraya Koenigii have been used in traditional or folk medicine for the treatment of rheumatisms, traumatic injury and snake bite and it has been reported to have anti-antioxidant, anti-diabetic and anti-dysenteric(Kong et al., 1986 and Keasn et al., 2007).

Serum creatinine is a possible surrogate marker of skeletal muscle mass. And because skeletal muscle is one of the target tissues for insulin, skeletal muscle mass might be associated with type 2 diabetes. It has been hypothesized that a low muscle mass reflects a low serum creatinine levels in diabetics (Harita et al., 2009; Hjelmesath et al., 2010).

A good glycemic control is the corner stone in diabetes management. In the present study both Murraya koeinigii and Olea europaea leaves exhibited hypoglycemic and hypolipidemic effects in streptozotocin-induced diabetic rats. The management of diabetes includes a combination of anti hyperglycemic drug treatment with lipid-lowering effects. Thus both the leaf extracts used in study, at two different doses (ML-4, ML-8 OL-4 andOL-8) showed a potent anti diabetic effect comparable to the synthetic drug metformin, overall being more pronounced in the Olea - groups(OL-4 and OL-8). These plants could be used as potential therapeutic drugs or dietary supplements for the management of diabetes type2 and dyslipidemia associated with it.
Since these plants have been used as dietary constituents since ages, their use could be potentially safe as Dietary supplements. A long term study however, is imperative as plant products are slow in action than the synthetic drugs and at higher doses may also exhibit a plateau effect which would not help in diabetes management (Maha and Amen et al., 2013).

Several alkaloids had been reported to possess similar anti-diabetic effects of glibenclamide (Paolisso et al., 1985, Gulfraz et al., 2008).

The possible protective effect of *Murraya koenigii* leaf extract against β–cell damage and antioxidant defense system of plasma and pancreas in streptozotocin induced diabetic rats was carried out and suggested that *Murraya koenigii* (carry leaves) out and suggested the *Murraya koenigii* treatment exerts a protective effect in diabetes by decreasing oxidative stress and pancreatic β–cell damage (Arulsevacn et al., 2007). Hypoglycemic effect of extracts of *Murraya koenigii* leaves along with the number of the species were studied which proved that they can be used as potent anti diabetic (Srinivasan, 2005). The aqueous extract of the *Murraya koenigii* leaves has been taken to evaluate the hypoglycemic activity in normal and alloxan induced diabetic rabbits with the effect of a standard hypoglycemic drug, tolbutamide. A single of variable administration of variable dose levels (200, 300 and 400mg/kg) of aqueous extract led to lowering of blood glucose level in normal as well as in diabetic rats (Kesari et al., 2005).

Oral administration of ethnolic extract of *Murraya koenigii* in streptozotocin induced diabetic rats for a period of 30 days significantly decrease the levels of blood glucose, glycosylate hemoglobin urea, uric acid and creatinine in diabetic treated group of animals (Arnselvan et al., 2006).

Extracts of *Murrya koenigii* resulted in pancreatic beta cell protection and functional pancreatic islets that produce insulin. This was evident by the normalization of plasma insulin and C-peptide levels, indicating endogenous insulin secretion, after treatment in streptozotocin-induced diabetic Swiss mice. Even the histochemical and immunohistochemical analysis suggest and islet protective and insulin productive role. Additionally, extracts of *Murrya koenigii* increased the levels of glucose-6-phosphate dehydrogenase enzyme, normalized hepatic and muscle glycogenesis, resulting in proper glucose utilization. The levels of post-prandial hyperglycemia were also reduced.
due to the pancreatic and intestinal glucosidase inhibitory activity of the extracts of *Murrya koenigii* (Dusane and Joshi, 2012).

The therapeutic use of *Moringa oleifera* parts in the Indian subcontinent dates back to Antiquity. In other parts of the world, in sub-Saharan Africa in particular, such a use appears not to have been known by the wide public, as it is being promoted by diverse organizations as an untapped opportunity (Thurber and Fahey, 2009; Torimiro *et al.*, 2009). At the writing of this manuscript (April, 2011), a search on the Internet, using the Google browser and the words moringa, drumstick, or malunggay as keys within page titles, reported nearly 90,000 websites. Most of these sites present this plant as a remedy to malnutrition and a vast range of ailments. On the Internet, *Moringa oleifera* is variably labeled as Miracle Tree, Tree of Life, Mother’s Best Friend, God’s Gift to Man, Savior of the Poor. In many regions of Africa, it is widely consumed for self-medication by patients affected by diabetes, hypertension, or HIV/AIDS (Dieye *et al.*, 2008; Kasolo *et al.*, 2010; Monera and Maponga, 2010). Yet, in a similar search of the Pub Med database of biomedical publications, merely 163 papers were fetched; 76% of them were published in the last decade.

Moussa *et al.* (2007) observed the results of oral glucose tolerance test (OGTT) in GK rats. The initial BG (10min) was 126.7±1.5mg/dl for the both two groups. The final BG (120min) was 273.3±14.0 and 272.8±11.2 mg/dl for the G and GM, respectively the two-way ANOVA showed that the two main effects of MO and time course, and also the interaction (MO and time course) were significant (P<0.05) for BG changes. MO significantly decreased BG at 20, 30, 45 and 60 min (P<0.05) compared to the control. The results of the OGTT in Wister rats, the initial BG (0min) was 91.6±5.4 and 96.0±3.1mg/dl for the C and CM, respectively. The final BG (120min) was 125.4±6.1 and 129.8±5.8 mg/dl for the C and CM groups was noted at 10, 30 and 45 min (P<0.05) after glucose administration.

Impaired TG storage into adiposities facilitates the formation in the bloodstream of small, cholesterol ester-poor, TG-rich low-density lipoprotein (LDL) particles. Hyperglycemia promotes glycation of these particles, a modification that extends their half-life in circulation. These particles are prone to oxidation and are potent initiators of atherogenesis and its vascular damages (discussed in more detail below). Diabetes-associated neuropathy, retinopathy, and nephropathy are some of the consequences of these damages (Dokken, 2008).
Obese people with type II diabetes can take *Moringa oleifera* leaf powder in their regular diet to reduce glucose levels and cholesterol in natural way (Prassanna kumar and Raviteja, 2013).

A study found that evaluating glycemia and lipid profile of offspring of diabetic wistar rats treated with *mentha piperita* juice. Hence, this study aimed at evaluating health complications weight loss, glycemic control and lipid profile of obese non-insulin dependent diabetes mellitus (NIDDM) patient’s i.e., Human beings with the respective plant has chosen one of the products in supplementation.

Barbalho et al. (2009) observed benefits in glucose and lipid profile after using peppermint juice in normoglycemic wister rats, plants contain a number of biologically active compounds able to modulate lipid and glucose metabolism, of which flavonoids and other antioxidant compounds’ play a central role for improving the lipid and hyperglycemic profile (Bera et al., 2010; Kaimal et al., 2010; Choudhary et al., 2006 and Leifent and Abeywardena., 2008).


Soya studies in adults with type 2 diabetes which have found significant improvements in glucose. Canadian study of adults with type2 diabetes documenting glycemic medication use at 73% and average HbA¹C of 7.3 % (Harris et al., 2005).

Soy intervention studies that have examined glycemic control in adults with type 2 diabetes have yielded in consistent results. Variation can come from study design particularly if there is a lack of control group (Ristic et al., 2006 and Shahbazian et al., 2007).
Dutch cohorts of the seven countries study, which found that a high consumption of legumes was related to a protective effect on the development of glucose intolerance and diabetics (Feskens et al., 1995). Soy products consumption is generally high in Asia. Population which could strengthen the ability of epidemiologic studies to determine associations between soy products intake and type 2 diabetes mellitus.

Shula et al. (1991) reported that Barley consumption in NIDDM patients improves low glycemic index and high insulinemic index (Urooj et al., 1998 and Lifschitz et al., 2002). Barley consumption improved impaired carbohydrate and lipid metabolism absorption less than other cultivars, appropriate diet for obese and diabetic patients.

Rendell (2005) studied that a barley based breakfast in diabetic patients observed reduction in postprandial glycemic peak with better insulin response (Hinata et al., 2007) overall metabolic improvements was observed in types 2 diabetes patients.

Key et al. (2006) reported that over weight men had significantly higher mean triglyceride concentrations compared with the control subjects (1.66.6 VS 74.2 mmol/L respectively; P < .006). Although there were significant differences in treatment (P < 0.27), group-by- treatment (P < 0.001) and group-by-time (P < 0.001), no pattern due to the β-glucose or RS content of the different tolerances was observed insulin responses were significantly affected by group (P<.001), treatment (P<.001), time (P < .0001), group–by–treatment interaction (P< .04) group–by-time interaction (P< .001),and treatment-by-time interaction(p<.001).

Barley has been used in fewer studies as a source of soluble fiber lower glucose and insulin responses have been reported after acute consumption of barley pearls (Wolever and Bolognesi, 1996; Yokoyamma et al., 1997 and Bourdon et al., 1999) and type 2 diabetic subjects (Urooj et al., 1998). The insulin requirement was reduced for type 2 diabetic subjects when barley was consumed the amount of soluble fiber in the barley meal affects the post prandial responses.

Wood et al. (2000) reported that Delayed or reduced carbohydrate absorption form the gut and not the effects of fermented was suggested as the mechanism of action of β-glucan in post prandial glucose metabolism. Consumption of whole grain barley products is consistent with the 2005 Dietary guidelines for Americans that recommended eating at least 3 servings of whole grains daily. A comprehensive review
of the scientific evidence suggests that increasing whole grain consumption can reduce the risk of coronary heart disease and diabetes, and can help with weight maintenance (Hu, 2005).

The science of life, Ayurveda, which evolved in ancient India (Tiwari, et al., 2005), was designed not only to treat diseases, but also emphasized the ways to prevent and manage long-term chronic health problems. The ancient Indian physicians were able to stabilize diabetes affectively, type II diabetes in particular, by advocating weight loss, dietary formulations and exercises like in the case of modern medicine. In the case of diet barley, one of the oldest cultivated grains (Newman et al., 2006) found prime importance as a substitute for other good grains. More than 2800 years ago (Bender et al., 1966), the Indian physician Charka mentioned that ‘Use of parched barley grains and its flour’ prevents the development of diabetes.

Large scale, prospective epidemiologic, studies suggest that whole grains and cereal-fiber containing products may reduce the risk of developing type 2 diabetes (Fung et al., 2002; Hu et al., 2000; Meyer et al., 2000; Montonen et al., 2003 and Salmeron et al., 1997 a & b 1997b).

The epidemiologic findings have been supported by clinical studies in which the intake of whole grains and cereal–fiber based containing foods had favorable effects on intermediate markers for diabetes, namely blood glucose and insulin levels in non-diabetes and diabetes (Halffrisch and Behall 2000 and Murtaugh et al., 2003).
# Table 1: Oats: Clinical Overview – glycaemic response

<table>
<thead>
<tr>
<th>References</th>
<th>Study Design</th>
<th>Results/Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Djorlk <em>et al.</em>, 2002</td>
<td>Glucose and insulin response in healthy subjects, Following a bread-based breakfast with and without muesli containing Oat well</td>
<td>Blood-Glucose level: lower Peak-concentration (-36%) Blood insulin level: Lower peak-concentration (-44%)</td>
</tr>
<tr>
<td>Jenkins <em>et al.</em>, 2002</td>
<td>Depression of the glycolic index by high levels of beta-glucan Oat well fiber in two functional foods tested in type 2 Diabetes</td>
<td>In a 50g carbohydrate portion each gram of Oat well β-glucan reduces the GI by 4 units</td>
</tr>
<tr>
<td>Kabir <em>et al.</em>, 2002</td>
<td>Four week low-glycolic index breakfast with a modest amount of soluble fibers in type 2 diabetic men</td>
<td>Intake of a low GI Oat well breakfast lowered postprandial plasma glucose peaks, as well as glucose and insulin response</td>
</tr>
<tr>
<td>Battilana <em>et al.</em>, 2002</td>
<td>Mechanism of action of beta-glucan Oatwell in postprandial glucose metabolism in healthy men</td>
<td>Oat well mechanism of action was shown as the results of delayed and reduced carbohydrate absorption</td>
</tr>
<tr>
<td>Ribordy <em>et al.</em>, 1997</td>
<td>Effect of pre-exercise cereal bar rich in Oat bran Oatwell on gastrointestinal transit and glycemia</td>
<td>Pre-exercise bar Oatwell dispenses glucose slowly and does not induces hypoglycemia</td>
</tr>
<tr>
<td>Tappy <em>et al.</em>, 1996</td>
<td>To determine the effect of increasing doses of Oatwell in extruded cereals</td>
<td>A 50% decrease in glycolic response is estimated to occur with 5g β-glucan from Oatwell</td>
</tr>
<tr>
<td>Pick et al., 1996</td>
<td>Oatwell oat bran bread products improve long-term control of diabetes</td>
<td>Reduction of 46% in the total glucose response from Oatwell</td>
</tr>
</tbody>
</table>

Subhash et al. (2007) conducted a study on diabetic patients and effect of lycopene supplementation. *t* test was used to assess statistical significance of the results between control and diabetic group before tomato lycopene supplementation and the P values <0.001 were considered as highly significant and p value <0.1 as insignificant.

Plasma concentrations of lycopene have been shown to have an inverse association with type 2 diabetes mellitus, fasting glucose, glucose tolerance or glycosylated hemoglobin in population–based surveys (Bates et al., 2004; Ylonen et al., 2003 and Ford et al., 1999) and cross sectional analysis (Armstrong et al., 1996; Polidori et al., 2000; Suzuki et al., 2002 and Chuang et al., 1998). However, these cross section observations cannot directly infer any cause effect relation. The low concentration of serum lycopene observed in patients with diabetes mellitus or impaired glucose metabolism may reflect a depleted antioxidant system due to diabetes mellitus or a change in diet after diagnosis.

A randomized trial of 57 patients with well controlled type 2 Diabetes mellitus reported that short term dietary supplementation with tomato juice 250 ml twice daily for 4 weeks, increased plasma lycopene and LDL resistance to oxidation, but did not change plasma glucose (Upritchard et al., 2000) long term high lycopene intake in preventing the development of type 2 diabetes mellitus.

A recent study demonstrated that administration of lycopene (90 mg/kg body weight) to streptozotocin-induced hyperglycemic rats caused a decrease in glucose levels, an increase in insulin concentration, a decrease in thiobarbituric acid reactive substances levels, increased total antioxidant status, and increased antioxidant enzyme activities (i.e., catalase, superoxide dismutase, glutathione peroxidase) with improvement in serum lipid profile. Reported that lycopene at doses of 1, 2, and 4 mg/kg has significant, dose-dependent antidiabetic action in streptozotocin-induced diabetic rats. In a clinical study investigating the role of lycopene in diabetic patients (N=133), lycopene reduced the risk of diabetic retinopathy (Suzuki et al., 2002).
Jane et al. (2000) reported that the tomato supplementation with high levels of vitamin E may decrease plasma C-RP levels in patients with type 2 diabetes.

**Section 2.4: Hypolipidemic activity and Antihypertensive activity of Herbal supplementation**

The effect of mahanimbine (carbazole alkaloid from *Murraya koenigii* leaves) on blood glucose and serum lipid profiles on streptozotocin induced diabetic rats mahanimbine showed significant similarity (Abu et al., 2007 and Rao et al., 2007). Intra-peritoneal administration of 50mg/kg and 100 mg/kg of mahanimbine once a week for 30 days showed anti-diabetic and hypolipidemic effect in diabetic rats. Mahanimbine in curry leaves showed appreciable alpha amylase inhibitory effects (IC 50 value of 83.72 ± 1.4mg/ml) and a weak alpha glucosidase (IC 50 value of 99.89 ± 1.2 mg/ml) significant (P<0.05) reduction in triglycerides, total cholesterol, low density lipoprotein and very low density lipoprotein levels of diabetic rats treated with mahanimbine 50 and 100mg/kg IP) as comparable to diabetic control (Dinesh kumar et al., 2010).

*Murraya koenigii* leaves on blood glucose and serum lipid profiles on streptozotocin-induced diabetic rats. When compared FTIR, ESI-MS, H NMR and C NMR spectra of isolated mahanimbine with the previously reported mahanimbine showed significant similarity, Intra-peritoneal administration of 50mg/kg and 100mg/kg of mahanimbine once a week for 30 days showed anti-diabetic and hypolipidemic effects in diabetic rats. Since, lipid abnormalities accompanying with atherosclerosis is the major cause of cardiovascular disease in diabetes. Therefore ideal treatment of diabetes, in addition to glycemic control, should have a favorable effect on lipid profiles high level of TC and LDL are major coronary risk factors (Temme et al., 2002). Further, several studies suggested that TG itself is independently related to coronary heart disease (Baaainton et al., 1992 & EI-harzmi and Warsy 2001). The abnormalities in lipid metabolism lead to elevation in the levels of serum lipid and lipoprotein that in turn play an important role in occurrence of pumatance and severe atherosclerosis, which affects with diabetes (Ravi et al., 2005).

When administered orally at doses of 300 mg/kg/day to high fat diet (HFD)-induced
obese rats for 2 weeks, the dichloromethane (MKD) and ethylacetate (MKE) extracts of *Murrya koenigii* leaves significantly reduced the body weight gain, total cholesterol (TC) and triglyceride (TG) levels (Birari *et al.*, 2012). These results suggest the potential role of *Murrya koenigii* to prevent obesity.

Lipid abnormalities which are frequently seen in diabetes patients result in a significant increase in cardiovascular mortality. Hence, a study conducted by (Kesari *et al*. 2007) wherein they evaluated the effect of one month oral administration of *Murrya koenigii* aqueous leaves extract in normal and streptozotocin (STZ)-induced severe diabetic rats at doses of 300 mg/kg bodyweight on various biochemical parameters. Results demonstrated that the fasting blood glucose (FBG) of treated animals decreased by 48.2%, total cholesterol (TC) by 30.8%, triglycerides (TG) by 37.1%. *Murrya koenigii* extract increased the HDL-cholesterol levels by 29.4%. Serum alkaline phosphatase values reduced by 33%, SGOT by 36.7% and SGPT by 32.2%. Additionally the serum creatinine levels reduced by 18.2% and urine sugar values decreased by 75% in the *Murrya koenigii* treated group. Thus the results indicate that besides lipid-lowering activity the aqueous extract of *Murrya koenigii* also reduced the severity of diabetes and its associated nephropathic complications.

Curry leaf extract possess the property to decrease blood cholesterol and blood glucose levels in diabetic mice and reduces the body weight after its treatment (Xie *et al*., 2005).

There are a large number of medicinal plants that are popularly used for diabetes mellitus (DM) and hypercholesterolemia treatment (Volpato *et al*., 2010). *Mentha piperita* is one of the plants most frequently used by the Brazilian population for therapeutic purposes. Its medicinal use includes anti-inflammatory, antispasmodic, and analgesic activities and the treatment of respiratory and gastrointestinal problems, as well as its antioxidant and anti per oxidant effects (Samarth *et al*., 2007).

Plant extract can also reduce the arsenic induced toxicity (Sharma *et al*., 2007; glucose, cholesterol, LDL–C and triglyceride levels (in diabetic rats); uric acid level (Barbalho *et al*., 2011); cholesterol/ HDL and LDL/HDL ratios (Sharafi *et al*., 2010). Iron absorption (Hur *et al*., 2007) malodos and volatile sulphur compounds in intensive care unit patients (Akdogan *et al*., 2004).
As medicines used to regulate glycemia and dyslipidemia are costly, the use of peppermint juice may be an alternative low cost strategy to treat non communicable disease associated with the insulin dysfunction. It can also be used to prevent the complication of gestational diabetes mellitus, thus preventing fetal hyperglycemia and hyper insulinemia, metabolic abnormalities and the metabolic syndrome in the offspring from mothers with Diabetes Mellitus. As peppermint also shows antioxidant and anti per oxidant effects, it also can prevent oxidative damages (Edris et al., 2003; Schmidt et al., 2009; Dorman et al., 2009 and Lopez et al., 2010).

Wister rats treated with *mentha piperita* (peppermint) juice male offspring from no diabetic dams (control group: 10 animals treated with peppermint juice) and from dams with streptozotocin induced severe diabetes (diabetic group: 10animals treated with water and 10 treated with pepper juice) were used. They were treated during 30 days, and after the treatment period, levels of glycemic control triglycerides, total cholesterol, fractions were analyzed in the adult phase. The offspring from diabetic dams treated with peppermint showed significantly reduced levels of glucose, cholesterol, LDL-C and triglycerides and significant increase in HDL-C levels. The use of the *mentha piperita* juice has potential as culturally appropriate strategy to aid in the prevention of diabetes mellitus, dyslipidemia and its complications (Sandra et al., 2011). Species of menthe are aromatic plants traditionally used as medicinal remedies and culinary herbs. Despite the promising results concerning the use of peppermint, it’s fundamentally important to perform further studies in order to evaluate its effects on human beings and the ideal doses to be used.

Several trials indicate that soy has a beneficial effect on plasma lipids (Crouse et al., 1999). A composite analysis of 38 clinical trials found that an average consumption of 47g of soy protein a day lead to a 9% decline in total cholesterol and a 13% decline in LDL cholesterol in subjects free of coronary heart disease(Anderson et al., 1999). Soy is rich in Isoflavones, compounds that are structurally and functionally similar to estrogen. Several animal experiments suggest that the intake of these Isoflavones may provide protection against coronary heart disease, but human data on efficacy and safety are still a waited.

Recent researches suggest that Soy bean dietary fiber place a role in the reduction of cholesterol levels in some hyper lipidemic individuals and has a major protective affect
on cardiovascular disease (Anderson et al., 1995, Lukaczer et al., 2006). Moreover, it improves the glucose tolerance in some diabetic patients; (Messina et al., 1999 and Jenkins et al., 2003). It increases the wet fecal weight and reduces the caloric density in some foods (Liu, 1999). Dietary fiber also seems to have a positive effect on diarrhoea and constipation and as a therapy of irritable bowel syndrome; (Bosaeus et al., 2004). It has anti-inflammatory and anti-carcinogenic effects on digestive system (Scheppach et al., 2004).

Soy foods may lower the risk of CAD stems from epidemiological observation that Asian population, whose diets include soy foods as a staple, have a lower incidence of CAD than populations consuming the typical western diet (Beaglehole, 1990). In addition, the striking similarities in chemical structure and biological activity between isoflavones and endogenous estrogen have caused some to extol the value of isoflavones in reducing cholesterol.

Studies have used a range of 40-150mg/day of isoflavones and examined their effect on both normocholesterolemic and hypercholesterolemic men and women (Nestel et al., 1997, 1999; Simons et al., 2000; dewell et al., 2002; Samman et al., 1999; Hodgson et al., 1998). In a key crossover study of nine mil/day hypercholesterolemia post menopausal women 80mg/day of isoflavones failed to alter serum lipoproteins significantly. The authors observed a downward trend in LDL (6%) and an upward trend in HDL (4%), resulting in an apparent reduction of 10% in the LDL/HDL cholesterol ratio between the placebo and treatment value. However all these differences, including total cholesterol (3%) were quantitatively very small and not statistically significant studies of adults with type 2 diabetes, which have also found no significant change in fasting insulin following consumption of an acute meal with 10g soya polysaccharide (Tsai et al., 1987) a soy and fiber supplement (50g of soy protein, 165 mg Isoflavones and 20g soy fiber ) for 6 weeks (Hermansen et al., 2001) a soya based meal replacement for 3-12 months(Oh et al., 2005) or Isoflavone supplements(132mg or 177mg) for 12 weeks(Hi et al., 2005; Hermansen et al., 2001, Gonzalez et al., 2007) in contrast, fasting insulin has been significantly reduced in adults with type 2 diabetes following consumption of SPI (30g of soya protein and 132 mg isoflavones) for 12 weeks (Jayagopal et al., 2002).
Animal studies have demonstrated that soy protein and Isoflavones, improve glyceamic control, lower insulin requirement and increase insulin sensitivity. Epidemiological studies have shown that elevated soy protein consumption is associated with decreased serum lipid profile (Nagata et al., 1998) it has also been reported that soy-based diet is effective in reducing total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and triacylglycerol (TG) and increasing the high density lipoprotein-cholesterol (HDL-C) suggesting that soy products may be beneficial in the management of type 2 diabetes mellitus (Zhan, 2005; Anderson et al., 1995 and Lopes et al., 1999).

Clinical trials and epidemiology studies have also documented that soy products was associated with serum lipids in subjects with obesity (Nanri et al., 2010), hyperlipedemia (Ho et al., 2007) and in post menopausal woman (Shahbazian et al., 2007) In addition, several studies have reported that beneficial effect of soy products consumption in subjects with type 2 diabetes mellitus several studies corroborate that the regular intake of legumes significantly decrease CVD (Anderson and Major, 2002).

Specific studies on soybean remark that the substitution in the diet of animal protein for soybean reduces the concentration of total and low density lipoprotein (LDL) cholesterol in plasma and decrease triglycerides. High-density lipoprotein (HDL) cholesterol concentrations are not affected significantly. Soybean protein, as well as reducing cholesterol and triglycerides levels, may produce an increase of lipoprotein. Consumption of soy bean protein helps to reduce cardiovascular disease risk (Anderson et al., 1995, 1999 and Kushi et al., 1999).

Soybean protein may be a good option in type 2 diabetes individuals due to its effect of hypertension, hypercholesterolemia, atherosclerosis and obesity, which are very common disease in diabetic patients (Hoh et al., 1996).
The food and drug administration approved a claim petition stating that diets low in saturated fat and cholesterol, which include 25g /day of soy protein, may reduce the risk of heart disease (Food and drug administration. 1999).

The mechanism to improve glycemic control during dietary fiber intake seems to be due to the effects of slowing carbohydrate absorption, so that dietary fiber reduces or delays the absorption of carbohydrates (Rubio, 2002).
In another study, 22 hypercholesterolemia subjects were fed barley or oat based foods for 6 weeks. Barley and oat flowers were used in weight equivalents amounts in breakfast cereal brain muffins and flatbread recipes. Compared to baseline levels, both the barley and oat diets lowered total cholesterol by about 4.7% LDL cholesterol was reduced by 13.9% in subjects fed the barley diet and by 7% in those fed the oat diet. The beta glucan contents of the two diets were also not reported, but total dietary fiber intake of the barley diet was significantly higher (40g) than for the oat diet (27g). Overall, the clinical data indicates that a minimum of 3 g of β–glucan from specified barley products is effective in lowering elevated cholesterol. This observation is consistent with data from oat studies that indicates 3 g of β-glucan from specified oat products is the minimum effective dose in lowering blood cholesterol (Newman et al., 1989).

Barely β - glucan has been shown to improve glucose and insulin control in some (Granfeldt et al., 1994; Rendell et al., 2005; Liljiberg et al., 1999 and Behall et al., 2005) but not all (Biorklund et al., 2005 and Bourdon et al., 1999), post prandial studies of healthy subjects and also diabetes.

Two studies have examined the effect of barley consumption in subjects eating their usual diet. (McIntosh et al., 1991) conducted a randomized cross over study in 21 hypercholesterolemia men who consumed barley or wheat (control) based foods for 4 weeks. The barley foods provided 8g of barley beta- glucan daily and included bread, muesli spaghetti, and biscuits made from barley bran and barely flakes. Total LDL cholesterol were lowered by 6% (P < 0.05) and 7% (P < 0.02%), respectively in subjects eating barley foods compared to wheat foods.

It was reported that hypertriglyceridermia, hypercholesteridemia and reduced HDL level were commonly seen in diabetes (Newairy et al., 2000; Colca et al., 1991). It has been suggested that either the removal of triglycerides from the circulation or its entry into the circulation or both was impaired in non-insulin- dependent diabetics (Sharma & Raghuram, 1990).

Jenkins et al., (1998) conducted a study on soy supplementation and weight management eleven obese volunteers took part in a 12-week study during 8 weeks of which, two of their 1000 k.cal control low calorie diets were replaced by soy based liquid formula (1month) or a milk based liquid formula (1 month) the mean weight loss
per month was 2.5 kg (P<0.05). With the soy formula, total and LDL cholesterol levels were reduced significantly over the month by (P<0.01) 10.0±2.7 % and (P<0.02) 17.5±5.6 % respectively. The results indicated that use of a vegetable soy protein supplement in a weight loss program, which induced moderate weight loss was associated with a significant reduction in blood lipids, whereas a control low caloric diet or milk based formula was not.

Mechanism for the reduction of blood cholesterol by the fibers include, the soluble polysaccharides were fermented in the colon. This molecule is absorbed and taken to the liver where it has inhibitory effect on the activity of hydroxymethy glutaryl O-A- Overducates thus reducing denovo cholesterol synthesising (Chen et al., 1986). Minor component in barely with value – added potential (Weber et al., 1991) reported that tocoltrienols had ability to lower serum cholesterol, other suggestion that the hypolipidemic effect of barley may contributed to presence of some saponins (Sidhu et al., 1987).

Sub clinical evidence from the last 40 years has documented that Oat β – glucans have an effect on blood cholesterol levels and control of lipoprotein metabolism (Braaten et al., 1994, Truswell et al., 2002). At the level of statistical significance, Biological relevance can be attached to very small changes in a marker. This is exemplified by reference to blood cholesterol levels (Total cholesterol, LDL - Cholesterol) in which at the population level, a few percent change has large implications on the risk of coronary heart diseases (Passclaim, 2005). Oat β- glucans are believed to favorably affect blood cholesterol and lipoprotein metabolism mainly by increasing viscosity in the small intestine. There are different theories concerning the mechanism of the blood cholesterol lowering effect of Oat β- glucans. One theory (Marlett, 1994) proposes that the viscous Oat β – glucan encapsulate bile acids, resulting in their excretion in the feces. Bile acids generally are recycled i.e., composition and metabolic activity of mucosa and micro flora in the colon. The end products created from pre - biotic fermentation in the colon is short – chain fatty acids. E.g. Butyric acid, that serves as nutrients for mucosal cells.

Oats are consistently hypocholesterolmic, regard less of whether they are incorporated is to an ad-libitum diet or as energy and fat restricted diet. Oats do not reduce cholesterol by displacing fat and cholesterol intake (Rispin et al., 1992) and
were shown to reduce blood cholesterol Levels even when a base line diet low in fat is
Consumed (Vanttorn et al., 1998).

LDL-Cholesterol, Which contains the highest concentration of cholesterol,
damages blood vessels because of its tendency to infiltration and accumulates within
arterial. Walls, LDL- cholesterol and especially small, dense LDL- Cholesterol, is also
more susceptible modifications including oxidation and glycosylation, which play
major roles in the development of atherosclerosis, high Concentration of serum high
density lipoprotein (HDL)-Cholesterol are protective against CHD, since HDL may
scavenge and remove excess cholesterol in the arterial wall and also protect LDL
against oxidation (National cholesterol Education Program, 1998). Elevated serum total
cholesterol and low density lipoprotein (LEL) - cholesterol levels associated with an
increased risk for coronary heart diseases (Grundey, 1997).

Based on epidemiological genetic and Physiologic evidence, several studies are
showing that few effects of Oats on to blood lipids in human, beings (De Groot et al.,
1963). A meta Analysis of 20 human trails, three 28g-servings of Oats Per day
Providing a daily total of 3g of beta-glucan reduces total Cholesterol by an average of
6mg /dl (HOLME,1990 and Vanholm et al., 1988).

Two studies have examined the effect of barely consumption in subjects eating
their usual diet. (Mclntosh et al., 1991) conducted a randomized cross over study in 21
hypercholesterolemia men who consumed barley or wheat (control) based foods for 4
weeks. The barely foods provided 8g of barely beta-glucan daily and included bread,
muesli spaghetti, and biscuits made from barley bran and barely flakes. Total LDL
cholesterol were lowered by 6% (P < 0.05) and 7% (P < 0.02%), respectively in
subjects eating barley foods compared to wheat foods.

Consumption of diets high in barley bran has been recommended in 2005
Dietary guidelines for Americans are reported to have a number of beneficial health
effects including reduced cardiovascular disease (Truswell, 2002 and Rimm, 1996), and
type 2 diabetes (Fung, 2002 and Liu,2000), which are leading cause of death in the
USA. These results have been attributed to the effects of the soluble and insoluble fiber
content of barely bran foods on the risk factors for these diseases including blood
glucose (Hallfrisch., 2000) , insulin (Willett., 2002) and cholesterol (Behall.,1997;
Leinonen,2000). Other more general beneficial physiological effects of consumption of
barely bran include reduced transit time which may reduce risk of Colon Cancer (Lupton, 1993) and rate of absorption of energy containing nutrients, which may reduce glucose and insulin responses and risk of obesity (Wirker, 1992). Numerous studies have demonstrated that barely bran is high in soluble fibers, such as β-glucan, lowering blood cholesterol.

Tappy et al. (1996) reported that many of the foods Contain carbohydrates that are digested and absorbed very rapidly from the intestine into the blood stream causing a high glycemic response or glyceamic index (GI) and rapid secretion of insulin from the pancreas increased insulin levels are believed to be a key factor in the development of several diseases.

Studies show positive metabolic effects of diets Containing Carbohydrates that are slowly digested in the intestine and have a low glycemic index, low GI may help prevent type 2 diabetes, Cardiovascular disease, metabolic syndrome and may reduce insulin resistance (Mckeown et al., 2004 and Wood et al., 2000).

A number of studies indicated that beta-glucan is the major active cholesterol – reducing components of oats when beta-glucans are fed in a dose –dependent manner, significantly greater reductions in blood cholesterol are observed as beta - glucans content increases (Behall et al., 1997). Furthermore treatment of oats with enzymes that destroy beta-glucan results in a loss of cholesterol-lowering potential oats (Judd and Truss well, 1981).

Studies have shown a link between tomatoes and lipid profile. In 98 healthy volunteers and tomato rich diet significantly increased high density lipo-protein (HDL)serum–cholesterol levels by 15.2% over 1 month of follow up (Blum et al., 2006).

In another diet intervention study, in which a 3 week low tomato diet and 3 week high tomato diet were consumed by 21 healthy subjects, the high tomato diet and low tomato diet reduced the total cholesterol and LDL – cholesterol serum concentration by 5.9% and 12.9% respectively (Silaste et al., 2007).

The tomato has even more nutrients for its against disease, potassium, vitamin B6, folic acid and niacin are all present in tomato and work together to help fight atherosclerosis (Beecher, 1998 and Malik et al., 2003). The potassium in the tomato
works against heart disease by its blood pressure lowering effect (Malik and Kashyap., 2003, and MacGregor., 2003).

The protective effect of lycopene on ischemic brain injury in rat brain homogenates has also been established. In one study, lycopene (5 µM and 10 µM) inhibited iron-catalyzed lipid peroxidation and nitric oxide production by about 31% and 61% respectively(Hsiao et al., 2004).

Ghasi et al., (2000) reported that Moringa oleifera (Drumstick leaves) regulates cholesterol levels in human beings (Mehta et al., 2003). Moringa oleifera (Drumstick leaves) works as an anti-hypertensive and regulates both diastolic and systolic blood pressures in diabetic patients (Faizi et al., 1994, 1992, 1995, 1998; Gilani et al., 1994; Limaya et al., 1995; Saleem and Meinwald, 2000).

Findings of a randomized, double-blind, controlled trial suggest that increased intake of soybean protein may play an important role in preventing and treating hypertension. Three hundred and two participants 35 to 64 years of age with an initial untreated systolic blood pressure of 130 to 159 mm Hg, diastolic blood pressure of 80 to 99 mm Hg, or both were enrolled. Study participants were randomly assigned to receive 40g of isolated soybean protein supplements per day or complex carbohydrate control for 12 weeks; 91.4% participants completed the intervention. At baseline, the mean systolic and diastolic blood pressures were 135.0 mm Hg (SD 10.9) and 84.7 mm Hg (SD 6.9), respectively. Compared with the control group, the net changes in systolic blood pressure and diastolic blood pressure were -4.31 mm Hg (95% CI, -2.11 to -6.51 mm Hg; p < 0.001) and -2.76 mm Hg (CI, -1.35 to -4.16 mm Hg; p<0.001), respectively, after the 12-week intervention. The net changes in systolic and diastolic blood pressure reductions were -7.88 mm Hg (CI, -4.66 to -11.1 mm Hg) and -5.27 mm Hg (CI, -3.05 to -7.49).

An overview of observational data obtained from population studies suggested that a difference in sodium intake 100 mmol/day was associated with average differences in systolic blood pressure of 5 mm Hg at age 15 to 19 years and 10 mm Hg at age 60 to 69 years (Law, 1991). Diastolic blood pressure is reduced about half as much, but the association increases with age and magnitude of the initial blood pressure. It was estimated that universal reduction in dietary intake of sodium by 50 mmol/day would lead to a 50% reduction in the number of deaths resulting from strokes and a 16% reduction in the number of deaths from coronary heart diseases. The first prospective
study using 24–hour are urine collections for measuring sodium intake, which is the only reliable measure, demonstrated a positive relationship between an increased risk of acute coronary events, but not stroke events, an increased sodium excretion (Tuomilehto et al., 2001). The association was strongest among overweight men.

Epidemiological, Clinical and animal studies suggests that fiber sources, including oats, can significantly aid in reducing blood pressure and or prevent the onset of hypertension. In two large epidemiological studies, Individuals who consumed 6-10g of daily had lower systolic (-3 to 5 mm Hg) and diastolic (-2 to 3mm Hg) blood pressure in comparison to their counterparts who ate 2-4g of fiber per day (Lichtenstein et al., 1986 and Elliot et al., 1987). Large perspective study showed that fiber intakes of more than 24 g/d were associated with a 57% reduction in risk for the development of hypertension in comparison to those who consumed less than 12g/d (Aschero et al., 1992).

Section 2.5: Effect of phytochemical studies on animal models and human beings

*Murraya koenigii* Leaves were popularly known as curry leaves in India. Phytochemical screening of *Murraya koenigii* revealed the presence of some vitamins, Carbozole alkaloids, triterpenoids, Phenolic compounds and mineral contents such as iron, calcium, zinc and Vanadium etc (Narendhirakannan et al., 2005; Chakraborty et al., 1965; Kong et al., 1986). In addition, carbazole alkaloids present in *Murraya koenigii* were reported to have anti oxidant activities (Tachibana et al., 2001).

The leaves of *Murray koenigii* contain proteins, carbohydrate, fiber, minerals, carotene, nicotinic acid, Vitamin C, Vitamin A, calcium and oxalic acid. It also contains crystalline glycosides, carbazole alkaloids, koenigin, girinimbin, iso-mahaniminbin, koenine, koenidine and koenimbine. Triterpenoid alkaloids cyclomahanimbine, tetrahydromahanimbine are also present in the leaves. Murrayastine, murrayaline, pyrayafoline carbazole alkaloids and many other chemicals have been isolated from *Murraya koenigii* leaves. Bark contains carbazole alkaloids like murrayacine, murrayazolidine, murrayazoline, mahanimbine, girinimbine, koenioline and xynthyletin.
The pulp of fruits generally contain 64.9% moisture, 9.76% total sugar, 9.58% reducing sugar and negligible amount of tannin and acids, besides containing 13.35% Vitamin C. The pulp of fruit also contains trace amounts of minerals, 1.97% phosphorus, 0.082% potassium, 0.811% calcium, 0.166% magnesium, 0.007% iron and remarkable amount of protein. (Bondi et al., 2011).

Polyphenols, commonly known as tannins, occur widely in many different plants, especially those from tropical regions. Their consumption by animals has adverse effects on productivity and health. They are present in various agro-industrial by-products such as Acacia nilotica pods, Madhuca indica seed cake, Mangifera indica seed kernel, Panicum miliaceum polish, Garcinia indica cake and Theobroma cacao pods (Makkar et al., 1990; Makkar and Becker, 1998). The unextracted leaves had negligible amounts of tannins (1.4 %) and condensed tannins were not detectable. The content of total phenols was 3.4 %. A total phenol content of 2.7 % has been reported by Gupta et al. (1989) for the un extracted leaves. At this concentration, these simple phenols do not produce any adverse effects when eaten by animals. In the extracted leaves, no tannins were detected and the content of phenols was very low (1.6 %). The tannins are soluble in aqueous organic solvents such as ethanol, methanol, acetone etc. (Makkar and Singh, 1992) and therefore, tannins would also be present in the isolated hormonal preparation obtained through the process in which the leaves are treated with 80 % ethanol. The absence of an increase in gas production on addition of polyethylene glycol (a tannin bioassay based on incubation of a feed in a buffered medium containing rumen microbes; Makkar et al., 1995) also indicated absence of tannins in the extracted and un extracted leaves.

Another group of anti-nutritional factors reported to occur in the unextracted Moringa leaves are the saccharides raffinose and stachyose which produce flatulence in monogastrics. According to Gupta et al. (1989) these compounds comprise 5.6 % of the dry matter in the unextracted leaves but occur in higher concentrations in legumes. They can however be removed to a large extent by soaking and cooking in water (Bianchi et al., 1983). These flatulence factors are determined after extraction in 80 % aqueous ethanol (Williams, 1984; Gupta et al., 1989), and would therefore be absent in extracted Moringa leaves. Other antinutritional factors present in unextracted Moringa leaves are nitrate (0.5 mmol/100 g), oxalate (4.1 %), saponin (1.2 %) and phytate (3.1 %). Trypsin inhibitor activity was not detected (Gupta et al., 1989). Phytates are present
to the extent of 1 to 5 % in legumes and are known to decrease the bioavailability of minerals in monogastrics (Reddy et al., 1982). The leaves of Moringa are quite rich in minerals and the presence of oxalates and phytates at concentrations of 4.1 % and 3.1 % respectively is likely to decrease the minerals’ bioavailability. Saponins from some plants have an adverse effect on the growth of animals but those present in Moringa leaves appear to be innocuous (did not show haemolytic activity), and humans consume them without apparent harm. Cyanogenic glucoside and glucosinolates were not detected in leaves (Makkar and Becker, 1997). Most of the anti nutritional factors mentioned above are soluble in aqueous ethanol and would most probably be absent in the extracted leaves.

*Moringa* leaves is the most used part of *Moringa oleifera* plant which has been reported after analysis of its phytochemical constituents, to be a rich source of β-carotene, protein, vitamin C, calcium and potassium and natural antioxidants; and thus, enhance the shelf-life of fat containing foods because it contains antioxidants. Carbohydrate compounds like rhamnose and a fairly unique group of compounds called glucosinolates and isothiocyanates were richly present in the *Moringa* leaves (Fahey, 2005).

The species from the menthe genus have substances that may be related to such effects. *Mintha Arvensis* contain menthol, menrol, engenol, thymol and hydrocarbonates. Menthol and other volatile compounds can be found in the leaves of *Mintha Piperita* (Samarth, 2007).

The observations in a study strongly prove the effective antioxidant property of tomato lycopene even though this effect is mainly due to lycopene, which account for ninety percent of total carotenoids and other phytochemical present in tomatoes (Frederich Khachik et al., 2002).

**Section 2.6: Hematological studies on Herbal supplementation**

The whole curry leaf was screened for hematological studies the rats were fed at doses equal to normal human intake it didn’t cause any adverse effect on food efficiency ratio (FER), red blood cell count (RBC), white blood cells (WBC), total count, differential counts or on the levels of blood constituents like serum electrolytes, blood urea, hemoglobin, total serum protein, albumin-globulin ratio, fibrin levels,
glycosylated hemoglobin and the activity of glutamic oxaloacetic transaminase (GOI), glutamic pyruvic transaminase (GPT) and alkaline phosphatase in serum were observed (Khan et al., 1995).

Soyinka. (2004) reported that Group A male animals (control) had a hemoglobin level of 15.5 g/dl and been the highest across the groups, while female animals of the same group had hemoglobin level of 12.5 g/dl. These groups are taken as been normal and a reference for the treated groups. Male animals in group B had hemoglobin level that is slightly lower than the control. Lowering of Moringa group than the control, might be due to some constituent in the Maringa leaf like glycosides and tannin, which are associated with toxicity. The female animals in the same group have hemoglobin level higher than in the control. Group C had the lowest hemoglobin level across the groups, with the male animal in the group having lower hemoglobin level than in the female. This indicated adverse effect of lead on hemoglobin level in this group. Group D had hemoglobin level higher than group C. However, the male animals had hemoglobin level, still lower than in the control. Group E male animals had hemoglobin level lower than the control. However, hemoglobin levels in female animal were higher than control.

Thus generally, lead administration reduces haemoglobin level in male and female animal groups, affecting the male more than the female. Moringa increases haemoglobin level, more significantly, in the female animals. Moringa phytochemical extract produced regenerative effect by causing increase in haemoglobin level, either when administered concurrently with lead or after the administration of the later later (lead). This effect is more significant in female than male animals.

**Section 2.7: weight loss and Health benefits of different Herbal supplementation**

Moringa preparations have been cited in the scientific literature as having antibiotic, antitrypanosomal, hypertensive, antispasmodic, antiulcer, anti-inflammatory, hypocholesterolemic and hypoglycemic activities, as well as having considerable efficacy in water purification by flocculation, sedimentation, autibiosis and even reduction schistosome cercariae titer. Moringa oleifera consumption have effect hypoglycemia and control diabetes in human beings (Arses, 1995; Faizi, 1998; Kar & Choudhary 1999; Makonneu et al., 1997; Mossa 1985 and Williams et al., 1993).
A study on radioprotective property of *Moringa oleifera* leaves, using adult swiss albino mice demonstrated that pretreatment with the methanolic leaf extract of *Moringa oleifera* confers significant radiation protection to the bone marrow chromosomes in mice (Rao et al., 2001). Another study shows that exposure to lead acetate reduces the level of antioxidants in bone marrow. Hence, rendering the tissues susceptible to the peroxidative damage (Michiels *et al.*, 1994 Ercal *et al.*, 2001). Study on the ethanol and aqueous extract of the whole pods and its parts i.e. the coat, see d, shows that the seed has ability to lower blood pressure (antihypertensive), and with the results of both ethanol and water extracts comparable showing a widely distributed effect. Thiocarbamate, isothiocyanate glycosides, methyl p-hydroxybenzoate and β-sitosterol, all isolated from ethanolic extracts activity directed fractionation of the pods of *M. oleifera*, have all shown hypotensive ability thus, encouraging their use as antihypertensives (Faizi *et al.*, 1998).

*Mentha piperita* leaves are an important medicinal herb (medicinal plant of the year 2004, (Saller, 2004). Oldest known medicinal plant species in eastern and western traditions although first described in 1753 by carbus linnaens worldwide (Foster, 1996).

A study showed that the effect of soy for the prevention and management of type 2 diabetes (Collen *et al.*, 2010). Protein intake has an important role in the prevention of obesity due to its satiating and thermogenic effects. A twelve-week clinical trial showed beneficial effects of soy meal replaced as a part of low energy diet for weight loss (Andreson *et al.*, 2007). Isoflavones, saponin and phospholipid content of soy have beneficial effects on weight loss (Fang and Badger, 2004).

Hokhtar *et al.* (2005) demonstrated that treatment of diabetic rats with barely and some of its comments could repair liver damage and restoring pancreatic β-cells deformation. This was manifested by the bio-chemical and immunoassay results and electron microscopy study where the hypoglycemic and hypolipidemic action of barley may be due to its contents generally and in specific to its content of chromium and amino acids.

Mahdi and Naismith (1991) studied that barley has been used as an aid in the treatment of a variety of conditions such as arthritis, digestive disease, diabetes, skin abnormalities, weight loss, detoxifying and cancer.
Epidemiological and clinical data suggested that fiber can aid in weight management and the prevention of weight gain and subsequent obesity (>30% over ideal body weight). 5-30 g doses of soluble or insoluble fiber per day can effectively reduce food intake and/or hunger and produce weight losses that last for up to 52 weeks (Rossner, 1992). Obese subjects who were placed on a calorie restricted diet that included as oat based products as the main meal once or twice daily lost significant amounts of weight after 23 weeks (Rytter et al., 1996).

The experimental study showed that when consumed 20-30 min before eating a meal oat β-glucans form a thick viscous fluid in the stomach and small intestine that stimulates the sensation of satiety and helps to limit appetite by reducing the desire for food intake the effect can help in weight control (Ludwig., 2000 and Salt Mann et al., 2001).

Stahl. (1992) showed that processing will increase the bioavailability of lycopene from tomatoes more significantly. The chemical form of lycopene is altered by the temperature, which makes it more easily absorbed by the body and lycopene is a fat soluble, absorption is improved when oil is added to the diet. Use of cooked tomatoes in the present study would have good absorption and helpful in digestion.