Chapter 1
Introduction
Chapter 1

Introduction

Diabetes mellitus is emerging as a chronic non-communicable disease of concern in developing and developed countries. Diabetes is on its way to becoming one of the most common health problem of the world. Currently, in many developing and newly industrialized nations there is an epidemic of diabetes. and the World Health Organization predicts that the rates of diabetes will double in next fifteen to twenty years. Already in some developing countries half of the adult population has diabetes. Even in developed nations, the rate of diabetes is increasing at alarming pace. More than 17 million Americans have diabetes and at the current rates of growth more than 10 percent of all Americans will have diabetes by 2010 (New Glucose Revolution, 2003). With changing environment, urbanization and altered life style, diabetes is also increasingly identified as a major cause of mortality and morbidity in India. Furthermore Indians have high ethnic susceptibility for developing diabetes at a younger-age. As per the available data, there are atleast 20 million people with diabetes in our country, which could also be a possible underestimate. Among European countries France, United Kingdom, Italy and Greece have 4.2 %, 3.5 %, 7.1 % and 5.9 % respectively of total population affected with diabetes. In African region, Number of people with diabetes (20 - 79 age groups) is about 2.5 million. There are an estimated 14 million people with diabetes in the Eastern Mediterranean and Middle East (EMME) Region. Diabetes affects some 49 million people in the South East Asian (SEA) Region (7.5 %), making it the largest region in context of diabetes population. In South and Central American region Estimated diabetes prevalence (20-79 year age group) is 4.8 % (Diabetes atlas. International Diabetes Federation, 2004)
The alarming rise in non-communicable diseases like diabetes, hypertension, lipid disorders warrants immediate attention of experts to develop better health care facilities and also plan preventive measures particularly against diabetes. Dietary treatment is the oldest of the three-treatment modality recommended for diabetes. Since the days of charak (1000 years BC), nutritional defects have been implicated in the developing of diabetes. Yet diet therapy in diabetes mellitus even today leaves much more to be desired. At present we can not speak about the complete cure of diabetes. In dealing with this chronic disorder our goals are maintenance of the well being of the affected individual and minimization of long-term complications. Newly evolving knowledge has greater impact on how the diet of diabetic patient is managed. A greater variety in insulin regimen and self-monitoring of blood glucose have allowed greater flexibility in meal planning. A liberal intake of carbohydrate is recommended which comprise 55-60% carbohydrate with optimal fat. There are many traditional beliefs regarding the type of carbohydrate in diabetic diet, which has been questioned in recent years. According to traditional thoughts simple carbohydrates are rapidly digested and absorbed and therefore diabetics should restrict these food preparations in their diets. But the rise of blood sugar after a meal not merely depends upon the amount of carbohydrate ingested but also the rapidity of the absorption which may vary with the fiber content, nature of carbohydrates, methods of cooking etc. and the ability of the food item to raise the blood sugar is measured as glycemic index. “A Ranking of the effect of the consumption of food on blood glucose relative to a reference carbohydrate is measured as glycemic index.”
The glycemic index (GI) is a ranking of foods on a scale from 0 to 100 according to the extent to which they raise blood sugar levels after eating. Foods with a high GI are those which are rapidly digested and absorbed and result in marked fluctuations in blood sugar levels. Low-GI foods, by virtue of their slow digestion and absorption, produce gradual rises in blood sugar and insulin levels, and have proven benefits for health. Recent studies from Harvard School of Public Health indicate that the risks of diseases such as type 2 diabetes and coronary heart disease are strongly related to the GI of the overall diets. The World Health Organization (WHO) and Food and Agriculture Organization (FAO) recently recommended that people in industrialized countries should base their diets on low-GI foods in order to prevent the most common diseases of affluence, such as coronary heart disease, diabetes and obesity.

Recently the glycemic index concept is an extension in the dietary management of diabetes mellitus and has greater influence. The glycemic index ranks the food on how they effect our blood sugar level. This index measures the level of blood sugar increases in 2-3 hours after eating. The glycemic index is about foods high in carbohydrates. Food high in fat likes most fast foods and fried foods and protein grains and legumes do not cause blood sugar level to rise much. It is still a common belief that it is plain table sugar that people with diabetes need to avoid but scientific studies shows that even complex carbohydrates i.e. baked potatoes, carrot can be even worse. (Mendosa, 2003).

The glycemic index concept is an extension of the fiber hypothesis suggesting that fiber consumption reduces the rate of nutrient influx from the gut. The glycemic index has particular relevance to those chronic western diseases associated with central
obesity and insulin resistance. Early studies showed that starchy carbohydrate foods have very different effects on postprandial blood glucose and insulin responses in healthy and diabetic subjects, depending on the rate of digestion. A range of factors associated with food consumption was later shown to alter the rate of glucose absorption and subsequent glycemia and insulinenia. At this stage, systematic documentation of the differences that exist among carbohydrate foods was considered essential. The resulting glycemic index classification of foods provided a numeric physiologic classification of relevant carbohydrate foods in the prevention and treatment of diseases such as diabetes. Since then, low-glycemic-index diets have been shown to lower urinary C-peptide excretion in healthy subjects, improve glycemic control in diabetic subjects, and reduce serum lipids in hyperlipidemic subjects. Furthermore, consumption of low-glycemic index diets has been associated with higher HDL-cholesterol concentrations and, in large cohort studies, with decreased risk of developing diabetes and cardiovascular disease. Case-control studies have also shown positive associations between dietary glycemic index and the risk of colon and breast cancers. Despite inconsistencies in the data, sufficient, positive findings have emerged to suggest that the dietary glycemic index is of potential importance in the treatment and prevention of chronic diseases (David JA Jenkins, 2000).

Consumption of low-glycemic index (GI) foods is effective in medium-term glycemic control in diabetic patients, according to a report in the August issue of Diabetes Care. "The use of diets with low GI in the management of diabetes is controversial, with contrasting recommendations around the world." A meta-analysis of randomized controlled studies to compare the effects of low-GI diets versus high-GI diets on
overall glycemic control in diabetic patients, assessed by reduced HbA1c or fructosamine levels. Fourteen studies including 356 patients were included in the analysis. All of the trials were of randomized crossover or parallel experimental design, and lasted a mean of 10 weeks. Ten studies reported on differences in postprandial glycemia on the two diet types. The researchers report that low-GI diets reduced HbA1c by 0.43 percentage points beyond that produced by high-GI diets. When they looked at HbA1c and fructosamine data together and adjusted for differences at baseline, they found that the difference in glycated proteins was -7.4% in favor of the low GI diet. Not adjusting for baseline levels or excluding the shortest studies did not significantly change the results. The meta-analysis provides objective evidence that targeting postprandial hyperglycemia via choice of low-GI foods has a small but clinically useful effect on medium-term glycemic control in diabetics, Nutrition and lifestyle approaches to diabetes prevention and treatment should be given as much attention as drug therapies. (Diabetes Care 2003)

The GI of foods has important implications for the food industry. Terms such as complex carbohydrates and sugars, which commonly appear on food labels, are now recognized as having little nutritional or physiological significance. The WHO/FAO recommend that these terms be removed and replaced with the total carbohydrate content of the food and its GI value. However, the GI rating of a food must be tested physiologically. (J B Miller, 2003)

A low-glycemic-index (GI) diet reduces weight and improves glycemic control in obese type 2 diabetic, according to the results of a randomized study published in the July issue of Diabetes Care. (Laurie Barclay, 2003)
"The typical Mexican diet includes beans (legumes) and corn tortillas (traditionally made), which are foods with a low GI. However, in Mexico and in the U.S., current dietary guidelines for people with diabetes focus on lowering dietary fat and increasing carbohydrate intake but do not mention the GI. (Arturo Jimenez 2003) This crossover-design study comparing flexible diets with high or low GI consisted of two 6-week periods with a 6-week washout period between treatments. Of 36 enrolled subjects with type 2 diabetes and body mass index (BMI) greater than 25 kg/m2, 14 subjects completed the study with eligible dietary records. During the low-GI diet, glycemic load and GI were lower, and subjects consumed significantly fewer high-GI carbohydrates, such as white-wheat bread, white long-grain rice, potatoes, high-GI fruits, and carrots. During the high-GI diet, dietary fiber was lower, and subjects consumed fewer low-GI carbohydrates, such as pinto beans. whole-meal wheat bread, and low-GI fruits. However, there were no differences during the two study periods in the amount of carbohydrates consumed, such as corn tortillas and dairy products. At the end of the study periods, A1c improved on the low-GI diet compared with the high-GI diet (P < .008)."Despite the worldwide controversy of the advantages and disadvantages of using the low-GI diet criteria for the nutrition education in diabetes, this study provides evidence that more flexible Mexican-style instructions, with an emphasis on the use of low-GI foods, decreased BMI and improved the metabolic control in individuals with type 2 diabetes," the authors write. "Although this diet helped to increase the adherence to the diet, it also promotes Mexican-style dishes, such as 'frijoles and tortillas.' increasing satiety as well as reducing body weight and improving metabolic control. Dietary recommendations for the treatment of Mexicans with type 2 diabetes may need to be reconsidered. (Gary D. 2003)."
Insulin resistance is a prevalent condition, in which insulin loses its normal physiological action. Since people were first classified as insulin resistant over 60 years ago, one of the main discoveries has been that insulin resistance clusters with other risk factors such as obesity, elevated tryglycerides and low density lipoprotein cholesterol, increasing cardiovascular disease risk. Appropriate nutritional treatment for insulin resistance is controversial. Two main approaches are drawn for diabetes recommendations. One of them is a high carbohydrate, low fat, and high fiber emphasizing on low glycemic index foods. The other is sharing calories between mono-unsaturated fatty acids and complex carbohydrates at the expense of saturated fat. Promising data have also emerged, showing that a high carbohydrate, high fiber-low glycemic index foods, low fat and exercise programs maintained through intensive counseling can decrease diabetes risk by over 40%. (Sievenpiper JL et.al.2002)

Obesity is among the most important medical problem in society today. The prevalence rates that have increased by 50% since the 1960s. In an attempt to combat this problem several efforts have advocated, decreasing intake of total fat and sugar, while increasing consumption of complex carbohydrate. Despite the recent reduction in fat consumption to near the recommended 30% of total energy, rates of obesity have continued to rise, suggesting the other dietary factors may play a critical role on body weight regulation. One such factor is glycemic index. (Ludwig DS. 2000).

Post-prandial hyperglycemia is an independent factor for the development of macrovascular complications. It is now recognized that normalizing post prandial
blood glucose is more difficult than normalizing the fasting glucose. Many factors
effect the postprandial blood glucose excursion. The glycemic index of the meal
depends on the nature of the ingested food and starch composition. Gastric emptying
is influenced by various factors including gut hormones such as GIPs and GLP1,
which potentiate insulin secretion, specially in its acute phase, now referred to as an
incretin effect. They also modulate glucagon secretion. Postprandial hyperglycemia is
limited by uptake of glucose by liver and by inhibition of endogenous glucose
production. Several studies demonstrate that Low glycemic index foods are very
useful to control postprandial hyperglycemia. (Gin H, 2000).

Consumption of a number of grains and grain extracts has been reported to control or
improve glucose tolerance and reduce insulin resistance. The inability of the body to
maintain normal glucose levels or to require excessive levels of insulin to do so has
been called glucose intolerance, impaired glucose tolerance and insulin resistance.
These conditions are associated with obesity and may be preliminary steps in the
progression to type 2 diabetes mellitus. Although dietary goals recommend the
consumption of three servings of whole grains per day, average consumption in the
United States is less than one serving per day. There are a number of mechanisms by
which grains may improve glucose metabolism and delay or prevent the progression
of impaired glucose tolerance to insulin resistance and diabetes. These mechanisms
are related to the physical properties and structure of grains. The composition of the
grain, including particle size, amount and type of fiber, viscosity, amylose and
amylopectin content all affect the metabolism of carbohydrates from grains.
Increasing whole grain intake in the population can result in improved glucose
metabolism and delay or reduce the risk of developing type 2 diabetes mellitus.
Whole grains can provide a substantial contribution to the improvement of the diets of Americans. A number of whole grain foods and grain fiber sources are beneficial in reduction of insulin resistance and improvement in glucose tolerance. Form, amount and method of cooking of these foods as well as the health characteristics, age and gender of the group of subjects studied are all important factors in the effectiveness of the foods in altering these responses. Dietary recommendations of health organizations suggest consumption of three servings a day of whole grain foods; however, Americans generally fall below this standard. Recent research using various grains and grain products effective in improving insulin resistance or lowering glycemic index by possible mechanisms of action. (Judith Hallfrisch, 2000)

Evidence regarding the influence of dietary fats, fiber, the glycemic index and sugar on energy intake and body weight. Although data from comprehensive long-term studies are lacking, published investigations suggest that the previous focus on lowering dietary fat as a means for promoting negative energy balance has led to an underestimation of the potential role of dietary composition in promoting reductions in energy intake and weight loss. More randomized clinical trials are needed to examine the relative utility of different putative dietary factors in the treatment of obesity. (Susan B. Roberts, 2001).

Recent survey data indicate that more than 50% of all adult Americans are overweight or obese. In parallel with this epidemic of weight gain in the general population, the incidence rate of type 2 diabetes mellitus (DM) is rapidly rising. Although their precise contributions are unclear, dietary factors are thought to affect body weight and the development of insulin resistance. Recent epidemiological data indicate that diets
rich in high-fiber whole grains are associated with lower risk of coronary heart disease (CHD) and type 2 DM. These data are consistent with results from recent metabolic experiments, suggesting favorable lipid profiles and glycemic control associated with higher intake of whole grains, but not with refined grains. It seems prudent, therefore, to distinguish whole-grain rather than refined-grain cereal products for the prevention of chronic diseases. (Simin L, 2001).

Evidence from both animal and human studies suggests that abnormal glucose metabolism plays an important role in pancreatic carcinogenesis. Several studies conducted, whether diets high in foods that increase postprandial glucose levels are associated with an increased risk of pancreatic cancer. Data support that impaired glucose metabolism may play a role in pancreatic cancer etiology. A diet high in glycemic load may increase the risk of pancreatic cancer in women who already have an underlying degree of insulin resistance. (Walter C, 2003)

The glycemic index values are useful as guides to food selection, but many factors influence the blood sugar response to foods. Combining foods into meals will change the impact of each food on blood sugar. High fiber vegetables have low glycemic indexes and trend to reduce the glycemic effects of the higher rated foods. The method of cooking also influences the blood sugar effect - cooking rice longer, for example liberates more free sugar from starch and increases the glycemic index. Differences in glycemic response reflect the rate that foods are digested and there are many factors. Variability of glycemic responses arises from variables in the same subject and variation between different subjects. There is less variability between the GI values of different subjects than there is within the same subject from day to day.
Starchy foods producing low glycemic responses have been identified, including legumes, pasta, barley, bulgur, parboiled rice and whole grain rye breads such as pumpernickel. Incorporation of these foods into diets have been associated with reduced blood glucose, insulin, and lipid levels. Low GI foods increase colonic fermentation, increase bacterial urea utilization, and increase production and absorption of short chain fatty acids in the colon.

There is controversy regarding the clinical utility of classifying foods according to their glycemic responses by using the glycemic index (GI). Part of the controversy is due to methodologic variables that can markedly affect the interpretation of glycemic responses and the GI values obtained. Recent studies support the clinical utility of the GI. Within limits determined by the expected GI difference and by the day-to-day variation of glycemic responses, the GI predicts the ranking of the glycemic potential of different meals in individual subjects. In long-term trials, low-GI diets result in modest improvements in overall blood glucose control in-patients with insulin-dependent and non-insulin-dependent diabetes. Of perhaps greater therapeutic importance is the ability of low-GI diets to reduce insulin secretion and lower blood lipid concentration in-patients with hypertriglyceridemia. (Wolever TM, 1991).

Different starchy foods produce different glycemic responses when fed individually, and there is some evidence that this also applies in the context of the mixed meal. A major reason appears to relate to the rate at which the foods are digested and the factors influencing this. A similar ranking in terms of glycemic response to specific foods is seen independent of the carbohydrate tolerance status of the groups tested. Potentially clinically useful starchy foods producing relatively flat glycemic responses
have been identified. Many of these are considered ethnic or traditional and include legumes: pasta; grains such as barley, parboiled rice, and bulgur (cracked wheat); and whole-grain breads such as pumpernickel. Specific incorporation of these foods into diets has been associated with reductions in low-density lipoprotein cholesterol and triglyceride levels in hyperlipidemia and with improved blood glucose control in insulin-dependent diabetic patients. To facilitate identification of such foods, it has been suggested that the glycemic response should be indexed to a standard (e.g., white bread) to allow comparisons to be made between the glycemic index of foods tested in different groups of subjects. The scope of application of this principle is subject to further investigation. It may be used to expand the range of possibly useful starchy foods for trial in the diets of diabetic patients (Jenkins, 1988).

The glycemic response of a food is a measure of the food’s ability to elevate blood sugar. The glycemic response is influenced by the amount of food you eat, its fiber content, fat content or amount of added fat, and the way the food is prepared. Highly glycemic carbohydrates are best consumed during and after exercise. They enter the bloodstream quickly and are readily available for fueling exercising muscles. Low glycemic carbohydrates enter the bloodstream slowly and are best eaten before exercise. They provide sustained longer-term energy, and help maintain stable blood sugar levels during extended exercise periods (greater than one hour).

Studies indicated that Glycemic Index was proposed in 1981 as an alternative system for classifying Carbohydrate containing food. Since then several hundred scientific studies and numerous Diets books have been published on the topic. However the clinical significance of the Glycemic Index remains the subject of debate. The
The purpose of this review is to examine the physiological effects of the Glycemic Index and the relevance of these effects in preventing and treating Obesity, Diabetes Mellitus and Cardiovascular disease. (David S Ludwig 2001).

Though many studies conducted all over the world to study various parameter of Glycemic Index, but not much work has been done in this field in North India. Though the food habits of north Indians differs drastically from rest part of the country and the world. Therefore this study was undertaken with the following objectives –

- To determine the glycemic index of various food articles commonly used in north India in diabetic and non-diabetic subjects.
- To recommend classification of food articles on the basis of glycemic index, particularly for the use of diabetic subjects.
- To find the utility of glycemic index in the management of diabetes mellitus.
- To establish a co-relation between various nutrients i.e. protein, fat, fiber with glycemic index.
- An attempt to change the glycemic index of food articles by combining them with other food articles.
- To develop a theory relating glycemic index with molecular parameters of food articles.