



Introduction

I. INTRODUCTION

Health is basic pre-condition for happiness and progress in life of an individual as well as the community. Quality health care is the life line for the growth and development of any country. The well known metabolic disease of diabetes mellitus, is ever growing and the prevalence is tremendously increasing day by day.

Nutritionally-related disorders and diseases (NRD) are often classified in an over simplified manner - under and over-nutrition. To some extent, this is useful since the greatest burden of NRD is more common in poor countries and communities where food intake is limited with associated hunger and famine. The problems have been growth retardation, PEM (Protein Energy Malnutrition), micronutrient deficiencies (especially iodine, iron, zinc, vitamins A and D, thiamin and folic acid) and malnutrition-related infection.

This has been in great contrast with the so-called chronic diseases of affluence, such as obesity, diabetes, macrovascular diseases (MVD) (stroke, ischaemic heart disease, peripheral vascular disease, osteoporosis and certain cancers). However, in recent times the poor segment of population experience to exhibit “chronic disease” and the more affluent experiences a resurgence of micronutrient deficiency or at least sub-optimal intake of, for example, folic acid, vitamin D, iron and iodine. Some of these factors contribute to “chronic diseases”. A combination of under and over-nutrition occur in the same person, family or community and lead to a complex spectrum of NRD (Wahlqvist, 2007).

Beyond this reconceptualization of the spectrum of nutritionally related disorders and diseases, first as the “Double burden of diseases” there are new emergent NRDs. These have to do, in the main, with environmental and climate change, with urbanization and with demographic change (Khor and Sharif, 2003).

Diabetes is defined as a state in which homeostasis of carbohydrate and lipid metabolism is improperly regulated by insulin. This results primarily in elevated fasting and post prandial blood glucose levels. If this imbalanced homeostasis does not return to normalcy and continues for a prolonged period of time, it leads to hyperglycemia and in due course it turns into a syndrome called diabetes mellitus (Tiwari, 2002).

According to the American Diabetes Association (2002) Type 1 diabetes or insulin dependent diabetes mellitus include β -cell destruction usually leading to absolute insulin deficiency and Type II diabetes results from a progressive insulin secretary defect on the background of insulin resistance.

The global number of people with diabetes mellitus is expected to be atleast 220 million in 2010 reaching 324 million in 2025 (Jayakumar and Nisha, 2005).

India is referred as the diabetic paradise of the world, in view of the high prevalence of diabetes mellitus in the country. The total number of diabetic persons in India is estimated to be three crores now and India ranks number one followed by China and USA (Poulose, 2005). By 2030, India will have 79.4 million diabetics, projects the World Health Organization (WHO, 1999).

Type II diabetes is an “iceberg” disease. According to recent estimates, the prevalence of diabetes mellitus in adults is around four per cent worldwide, and this means that over 143 million persons are now affected. It is projected that the disease prevalence is nearly five per cent by the year 2025, with global diabetic population reaching 300 million of this, close to 77 per cent of the global burden of disease is projected to occur in the developing countries (Park and Park, 2000).

Diabetes mellitus as a major non-communicable disease, diabetes mellitus alone claims approximately eight per cent of the total budget allotted for health in several countries like India (Misra, 2001). It is predicted that diabetes mellitus is

the major non-communicable disease, in the next millennium. A recent report of World Health Organization (2000) pointed out that India have the greatest magnitude of increase, approximately 170 per cent by the year 2025AD. By that time, India have the dubious distinction of having the maximum number of diabetes in the world of note, most of these diabetic persons in India shall be in the most productive years of their lives. It is a particularly worrisome scenario for India since it has to tackle twin problems of over diabetes and its complications being chronic in nature required considerable time and finances for its management and result in a substantial loss of productivity.

Banerji and Bajaj (2004) conducted a study in U.S.A showed a higher prevalence of Type II diabetes and coronary artery diseases among urban and migrant Asian Indians mainly due to increased frequency of insulin resistance.

Viswanathan *et al.*, (2002) stated that Type II diabetes is emerging as major public health problem and occur a decade earlier in our country when compared to the western countries. WHO cautions on the worldwide rise prevalence of diabetes from four per cent in 1995 to nearly five per cent at present of 2005. WHO predicts that the number of cases of diabetes mellitus increase from 135 million in 1995 to 300 million in 2025 (Dunstan *et al.*, 2002). The increase is observed in 42 per cent of the population in developing countries and 82 per cent in developed countries. Two third will come from India. China, USA, Russia and Japan (Hayman, 2002).

King (2001) pointed that India has the largest number of diabetes with 33 million in 2000 and cautioned that it increase to 57 million by the year 2025. Dunstan *et al.*, (2002) reasoned out that the tremendous increase in diabetes mellitus is due to the increase in elderly population, modern life style and industrialization. Studies conducted in Kerala by Viswanathan *et al.*, (2002)

revealed that the prevalence rates to be 12.4 per cent in urban areas and 2.4 per cent in rural areas.

Ramachandran *et al.* (2002) reported that Indian faces a grave health care burden due to the high prevalence of Type II diabetes. Epidemiological data from different parts of the country shows a rising prevalence of diabetes is more common in the urban areas compared to rural areas of the country.

Diabetes, a global public health problem affecting human beings at all stages of development and now emerging as a pandemic and the year 2025, three quarters of the world's 300 million adults with diabetes will be in non-industrialized countries and almost a third in India and China alone (Nalwade *et al.*, 2003).

Type II diabetes has dramatically increased in children and adolescence over the past ten years and the prevalence of Type II diabetes and obesity in western world is steadily increasing day by day (Knight *et al.*, 2005).

Boyle *et al.* (2001) reported that the diabetes prevalence is increasing among the elderly and estimated that the 3.5 million individuals aged above 65 years with diabetes in 2000 will increase upto five million individual by 2010.

Prasanna *et al.*, (2003) identified the various symptoms of diabetes viz. polydipsia, polyuria, polyphagia, sudden unexplained weight loss, slow healing cuts, skin infections, blurred vision and unexplained weakness. If a person experienced with the above symptoms, diabetes is confirmed. A diabetic should have proper control of blood glucose which helps to avoid the increase in the risk of complications.

Punnonen (2001) revealed that the diabetes mellitus is recognized clinically by the presence of characteristic symptoms such as excessive thirst, polyuria,

otherwise unexplained weight loss or one or more of the many complications associated with or attributable to the disease.

According to Bakhru, (2001) diabetes is described by most biological doctors as ‘prosperity disease’, primarily caused by systematic over eating and consequent obesity. Excessive intake of foods demands the pancreas and eventually paralyses its normal activity. It has been estimated that the incidence of diabetes is four times higher in person with moderate obesity and 30 times higher in person with severe obesity.

Fioretto and Solini(2005) expressed that the Type II diabetes is reaching epidemic proportions throughout the world. Hypertension, dyslipidemia, long duration of diabetes and poor glycemic control are the important risk factors for the precipitation of Type II diabetes.

People with low birth weight increased the risk of developing Type II diabetes in adulthood (Ozanne *et al.*, 2004). It is well established that the risk of developing Type II diabetes is closely linked to the presence and duration of overweight and obesity and sedentary life style (Nesto, 2003 and Torgerson *et al.*, 2004).

In diabetes increased blood sugar level causes different kinds of complications. It reduces life expectancy by five to seven years and increases the risk of heart disease by 50 times, renal problems by 17 times and gangrene by 25 times (American Diabetes Association, 2004).

Diabetes often goes hand in hand with heart and vascular diseases. Persons with diabetes are at a high risk for heart attacks, strokes and high blood pressure (Manson *et al.*, 2002). The leading cause of death in person with diabetes is heart disease (Kaveri *et al.*, 2004). Cardiac complications are responsible for 80 per cent of death and 75 per cent of hospitalization in diabetic patients.

Vargheese (2000) and Olefsky (2004) remarked that uncontrolled diabetes leads to several complications like retinopathy, nephropathy, neuropathy, coronary artery disease, cerebrovascular disease, atherosclerotic vascular disease, diabetic foot and hypertension. This shows that its quite important for a person to be free from diabetic complications to lead a healthy life, so various measures have to be taken to keep the blood glucose in control.

Diabetes complications are common and almost triple the annual cost of managing diabetes. Micro vascular complications are the major risk in Type I diabetes, while macro vascular complications are the major causes of mortality and morbidity in Type II diabetes (Bate and Jerum, 2003).

Increasing level of fasting blood glucose and postprandial blood glucose are a contributing factors to the development of atherosclerosis by a rapid and large increase in blood glucose levels and the possibly that the postprandial “hyperglycemic spikes” may be relevant received and much attention.(Antonio, 2005).

Type II diabetes is a metabolic disease associated with a wide range of co-morbidities and complications, including retinopathy and loss of vision, nephropathy and end stage renal disease, peripheral neuropathy, cardiovascular diseases, lower extremity amputations due to diabetic foot (Ravid and Rachmani, 2005).

Edmisson (2005) stated that diabetes is a chronic disease associated with multisystem complications. In particular, cardiovascular and renal demise are almost certain in individuals who have diabetes with cardiovascular complications accounting for over 50 per cent of mortality among patients who have Type II diabetes mellitus.

Diabetic nephropathy is the leading cause of kidney disease in patients starting renal replacement therapy and affects approximately 40 per cent of Type 1 and 2 diabetic subjects (Gross *et al.*, 2005).

According to Tedesco *et al.* (2004) hypertension is frequently associated with diabetes mellitus and its prevalence doubles in diabetics compared to the general population.

Hore *et al.* (2002) reported that diabetes greatly increases the risk of heart diseases and stroke. Part of the reason for this cardio vascular disorder is that diabetes affects cholesterol and triglyceride level.

Martin *et al.* (2004) stated that diabetes mellitus is the most common cause of neuropathy in the western world. Recent studies estimate prevalence around 28.5 per cent but results vary depending on measure used to define diabetic neuropathy.

Agarwal (2002) and Sandoz *et al.* (2004) found that diabetic nephropathy is a major cause for the end stage renal disease. The major intervention to prevent or reduce the rate of diabetic nephropathy is control of blood sugar. The prevalence of end stage renal disease (ESRD) in subjects with Type II diabetes increased in recent decades throughout the world.

Prevention is the only viable long term strategy to tackle the problem at its origin. Developing countries can ill afford to bear the financial cost of diabetes and its consequences and hence efforts are needed for its management, control and prevention.

Harris *et al.* (2003) and Bouche and Goldfine (2003) explained supporting diabetic subjects to make changes in their physical activity and dietary habits prevent the onset of Type II diabetes. Irons *et al.* (2004) found that intensive life

style modifications through alternations in diet and improvement in exercise have delayed the development of the Type II diabetes.

Sato *et al.* (2003) suggested that preventive measures at three levels- primary (avoiding the occurrence of disease) secondary (early defection and reversal) and tertiary (prevention or delay of complications). The major purpose of physical exercise for primary prevention and treatment of life style related disease is to improve insulin sensitivity. It is known that during physical exercise, glucose take up by the active muscle raises seven to twenty times over the blood level depending on the intensity of the work performed.

Exercise is an important tool in managing diabetes. It is especially good for diabetes and it is as helpful as meal planning and diabetes medicine. Most people with diabetes who exercise regularly require less medication because exercise lowers their blood sugar.

Diabetes is best treated by carbohydrate restricted diets. Long term studies concluded that low carbohydrates with high fibre diets are suitable for Indian persons with diabetes. The advantages of such a diet show sustained control of hyperglycemia, reduction in high triglyceride level, it does not over strain the pancreas and improves the peripheral sensitivity of insulin and the incidence of long term complication in blood vessels also appears to be low on such a diet (Rao *et al.*, 2003).

Roche (2004) and Mani *et al.*, (1997) emphasized that diet plays a pre-eminent role among the various modalities of treatment used in the management of diabetes mellitus as it unlikely produced any adverse effect. Unfortunately only about 10 per cent of diabetes can be controlled by diet alone.

Vinik and Jenkin (2002) highlight that the high fiber diet help the diabetic persons in reducing postprandial hyperglycemia and insulin secretion and in decreasing the raised plasma lipids and also help in the reduction of body weight.

Manson *et al.*, (2002) mentioned that healthy eating, regular physical exercise and healthy life style help to keep blood glucose level as near to normal as possible.

Life style changes resulted in a greater reduction in the incidence of Type II diabetes over four years and produced greater weight loss in a clinically representative obese population (Torgerson, 2004). Harris *et al.*, (2003) reviewed that the subjects adopt regular physical activity and appropriate dietary habits to prevent the onset of Type II diabetes.

Diabetes mellitus is one of the oldest diseases known to mankind and yet with the tremendous scientific advances witnessed in this century, medicinal science cannot claim that it knows all that needs to be known about this disease, including its management. This is the main reason for the persistent interest all over the world to explore alternative remedies from the so called 'alternative systems' of medicine (Andallu, 2002).

The term "neutraceutical" was first coined by Dr. Stephen DeFelice in 1989, combining "nutrition" and "pharmaceutical". The Merriam-Webster Dictionary defines the word as "a foodstuff (as a fortified food or dietary supplement) that provides health benefits.

The main attribute of neutraceuticals that places them in a separate category is that the food provides some health benefit beyond standard nutrition, such as a positive physiological effect or the prevention or amelioration of chronic disease.

A somewhat synonymous term coined a few years earlier is "functional food". While this usually refers to the whole food product, rather than a

component, there is often no clear distinction between the two terms in many of their uses.

This is a critical point with nutraceuticals, as their producers seek to claim health attributes that impinge on the domain of pharmaceuticals, but must not do so to avoid running afoul of regulation. As a result, the claims are generally of the nature that a nutraceutical product generally provides a reduced risk of certain diseases, but definitely cannot claim curative effects (Devanport, 2005).

Neutraceuticals, foods or food components are helpful in prevention or control of diseases. Basically these are made from herbal and/or botanical raw materials and is a rapidly growing industry (7.12 per cent per year) with more than 100 million people in the U.S using these natural products. With extensive anecdotal data on exciting health results, nutraceuticals promise significant contributions to disease prevention and health promotion.

“Neutraceuticals” or “Phytochemicals”, are the recent evolution of the term that emphasizes the plant source of most of these health protective and disease preventing compounds. A true nutritional role of phytonutrients is becoming more probably every day as research uncovers more of their remarkable benefits. In fact, the term phytonutrients better describes the compounds “quasi-nutrient” status. In future, phytochemical may indeed be considered as essential nutrient.

In a clinical trial, diabetic subjects receiving 15 milliliters of aloe gel twice a day for 42 days experienced that 43 per cent of them have reductions in blood sugar and blood triglycerides, while control group experienced no change in this biochemical profile (Yougchaiyudha *et al.* 1996 and Bunyapraphatsara *et al.*, 1996)

One of the most promising natural treatments for diabetes is Alpha Lipoic Acid (ALA). One research review looked at the 15 clinical trials that had been

performed with ALA to date. The researchers concluded that three-week treatment using 600 mg per day of the ingredient reduced the main symptoms of diabetic neuropathy (a complication of diabetes that affects the nerves) and there is an improvement in motor and sensory nerve conduction in the lower limbs (Ametov, 2003)

Nutrition related studies confirmed that fenugreek seeds have hypoglycemic effect. The herb's high fiber content forms a gel in the stomach, which slows gastric emptying and delays glucose absorption. The researchers concluded that, the continuous use of fenugreek seeds improves glycemic control and decreases insulin resistance in mild Type II diabetic patients (Gupta, 2001)

Omega 3 fatty acids present in fish also help to prevent and control diabetes. In one trial of overweight individuals with insulin resistance, 50 per cent of them showed a clinically significant change in insulin related function after taking Docosahexaenoic Acid (DHA). (Mundell, 2002). Another study found that diabetic women, who regularly consumed fish, reduced their risk of heart disease by as much as 64 percentages (Hu, 2003)

Soy protein has been observed in animal and human studies to have anti-diabetic activity. Maintaining a low glycemic index score, it is well known for its heart-protective properties. One study found that diets supplemented with soy proteins improved insulin resistance and blood sugar and cholesterol levels in post-menopausal diabetic women (Jayagopal, 2002).

The hypoglycemic effect of defatted seeds and water soluble fiber from the seeds of *syzygium cumini* (Linn) were studied and concluded that defatted seeds significantly lowered blood glucose levels and improved Oral Glucose Tolerance (OGT) in both normal and diabetic rats whereas water soluble fiber neither lowered nor improved OGT (Pandy *et al.*, 2002).

Gymnema Sylvestre an Indian medicinal plant has long been known to possess anti diabetic activities. It is popularly known as “Gurmar” in Hindi meaning sugar destroyer. Extract of the plant have been reported to possess a variety of actions related to anti diabetic properties like reduction in insulin requirement and increase in beta cell function (Siddiqui *et al*, 2000).

The effects of aqueous extract of Hibiscus Rosa Sinensis leaves on blood glucose tolerance were investigated in induced diabetics. Repeated administration of the extract (250 mg/kg for 7 days) significantly improved glucose tolerance (Sachdewa 2001).

Numerous nutraceuticals like aloe Vera, banaba, Bittermelon, fenugreek seeds, fish oils, Gymnema sylvestre and soy has showed anti-diabetic activity in diabetes management. But still, the role of functional foods in diabetic is in its infancy.

Proper control of diabetes mellitus can only prevent development of complications. Therefore the present research study is originated to find the anti-diabetic effect of some commonly used nutraceuticals from plant sources among the selected diabetic subjects with the following objectives.

- (a) Study the socio-economic background, dietary pattern and family history of the selected diabetic subjects.
- (b) Analyse the blood glucose, glycoslyated haemoglobin and lipid profile among the selected diabetic subjects and
- (c) Effect of supplementation of selected nutraceuticals on the blood glucose and lipid profile of the diabetic subjects in the study groups, before and after supplementation of 90 days.