CHAPTER – 1

INTRODUCTION

“The Doctor of future will no longer treat the human frame with drugs, but rather will cure and prevent disease with nutrition.”

— Thomas Edison

1.1 BACKGROUND OF THE STUDY

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces (WHO, 2014). Insulin is a hormone that regulates blood sugar. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body’s systems, especially the nerves and blood vessels. There are two types of diabetes, Type 1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset), Type 2 diabetes (formerly called non-insulin-dependent or adult-onset) is the body’s ineffective use of insulin. The other categories of diabetes include gestational diabetes (a state of hyperglycemia which develops during pregnancy) and "other" rarer causes (genetic syndromes, acquired processes such as pancreatitis, diseases such as cystic fibrosis, and exposure to certain drugs, viruses, and unknown causes). In the recent past, much importance has been given to awareness against intermediate condition of Impaired Glucose Tolerance (IGT) and Impaired Fasting Glycaemia (IFG) by the health care professionals. For instance, it is referred as pre-diabetic because of its leading progress towards type 2 diabetes, even though this is not predictable.
Type 2 Diabetes is a major health threat to every nation because nearly 90 percent of the world diabetic population having Type 2 Diabetes due to globalization, migration, life style changes, inadequate physical activity and diet faddism (Santos, 2014). Further, it causes some serious complications like vascular, neural, nephro and retino problems in heart, eye, brain and kidney. Shockingly, the majority of 382 million people with diabetes are in the age group of 40 to 59 years of which 80 percent of the diabetic population lives in middle and low income countries (WHO, 2014). More than 21 million live births were affected by diabetes in pregnancy by the year of 2013. It will definitely rise the health and economic burden of both the individual and the nation. It has also been declared by international diabetic federation that every six seconds a person dies from diabetes.

Ramchandran et al, (2012) states that the prevalence of diabetes constituted chiefly by type 2 diabetes (T2D), a leading global public health threat. The prevalence among adults aged 20-70 years is expected to rise from 285 million in 2010 to 438 million by the year 2030. While T2D poses a huge economic burden to all nations, specifically developing countries bear the highest burden since more than 80% of cases occur in south Asian countries. Now, the prevalence estimated of diabetes and impaired glucose tolerance (IGT) are high for all Asian countries and are expected to increase further in the next two decades. The present trend indicates that more than 60% of the world’s diabetic population will be in Asia. The national prevalence has increased by two fold or more within a decade in many countries and rural prevalence has increased considerably in India, Nepal and China.

Unfortunately, India is the second largest country with diabetic population in the world. According to the Diabetes Atlas 2006 published by the International Diabetes Federation, the number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken.
1.2 STATEMENT OF THE PROBLEM

Globalization plays an important role in nutrition transition and subsequent growth of diet related chronic diseases (DRCDs). In past centuries, communicable diseases dominated but now 50 percent of the health burdens in developing countries are due to non communicable disease. Because of lifestyle, diet, obesity, lack of exercise and are important contributing factors in causation of non communicable diseases (NCD) to these factors in particular will be increasingly important for the development of future health care strategies for developing world (Debas et al, 2006).

According to WHO 2015, chronic disease are the largest cause of death in worldwide led by Cardio Vascular Diseases (CVD) (17.5 million death in 2013, The Atlas of Heart Disease and Stroke), and followed by cancer (7 million death) and chronic lung diseases (4 million deaths) and diabetes mellitus (1 million). Obesity has became an important global public health concern because it is core risk factors of development of DRCDs such as CVD, diabetes as well as hypertension and cholesterol, Globalization Knowledge Network (2002-2005).

Further, WHO is currently working on herbal treatments and to confirm its medical efficacy as well as safety of the therapeutic use in the diseases like HIV/AIDS, malaria, sickle cell anemia, and diabetes. However, it estimates that about three quarters of the world currently uses and other forms of traditional medicines for their ailments. Nearly, 45,000 plant species in India in which 3,000 medically plants identified officially, but traditional parishioners use more than 6,000 species for treating the various diseases.

Chang et al (2007) opined that many alternative therapies such as nutritional supplements, herbal medicines, nutritional advice, spiritual healing and relaxation techniques are preferred among the
diabetic population. Among the herbal remedies, true cinnamon, bitter gourd garlic and fenugreeks are used for cooking as well as to treat the diabetes in the many countries such as India, United States and China, (Ching et al, 2013). The country which uses traditional medicine for diabetics were Malays (75%) followed by Indians (18%) and Chinese (6%). This clearly indicates that local herbs were underutilized, as not much study has been done on useful local herbs in treating or controlling diabetes. (Ching et al, 2013)

India is having abundance of herbs, it is high time the research studies be conducted on herbal usage as food and as well as medicine in preventing and controlling disease like diabetes which is becoming a threat in South Asian countries. In India, the problem of lifestyle and its consequent diseases needs to be addressed vigorously by all public health care personnel. Thus this study was ventured upon as a modest attempt to address the issues by utilizing herbal usage for the control of diabetes.

1.3 SCOPE OF THE STUDY

Non-communicable diseases including cardiovascular disease, diabetes, asthma, chronic respiratory infections and cancers are the leading cause of death worldwide; an estimated 36 million people die from such disease each year, roughly two out of three deaths. Globally 80 percent of fatalities occur in low and middle-income countries. Cost-effective interventions to reduce the burden of these diseases and providing sustained action can prevent millions of premature deaths
According to Manisha et al, 2007 to date, over 400 traditional plant treatments for diabetes have been reported, although only a small number of these have received scientific and medical evaluation to assess their efficacy. The hypoglycemic effect of some herbal extracts has been confirmed in human and animal models of type 2 diabetes. The World Health Organization Expert Committee on diabetes has recommended that traditional medicinal herbs be further investigated. This has led to the revival of herbal treatments for a large number of diseases. Since, the world population is growing at an alarming rate, there is a demand of herbs either as food or medicine. Accordingly, an effort has been made to describe the plant with such uses but has to be explored for their claimed effect. In addition to use as a food and also to highlight the medicinal properties of the plant with easy to assess, affordable and available in community, the present investigation was set to evaluate the anti diabetic potential of the dried leaf powder of *Pisonia grandis* R.Br. and standardization of recipes and organoleptic evaluation. On searching for scholarly articles *Pisonia grandis* R.Br. leaves the number of results shows were 7-8. This adds to the credibility of the study.

### 1.4 BRIEFING ON THE SELECTED PLANT SPECIES

Elumalai et al, 2012 publicized in his review that different parts of *Pisonia grandis* are extensively used in tribal folk medicines and also used as an Indian traditional medicine for an anti diabetic, anti-inflammatory, wound healing, diuretic, analgesic, filariasis, dysentery and rheumatic disorders. This creates interests towards *Pisonia grandis* in giving treatment for Rheumatoid Arthritis (RA) and Diabetes. Hence, there is a dire need to investigate the therapeutic potential and cost effective treatment options in diabetes. Our interest in investigating the use and nutritional values of this plant is based in the fact.
According to Deshpande and Bhalsing (2013), the traditional system of medicine used *Cassia auriculata* L. plant to treating the Rheumatism and Conjunctivitis. And the other parts of the plant used to overcome the symptoms of diabetes and it also one of the ingredients in anti-diabetic polyherbal formulation. To analyzing the chemical composition of *Cassia auriculata* L using GC-MS (Gas Chromatography and Mass Spectrometry) analysis of seed extract of *Cassia Auriculata* L. had ester, fatty acid amide, terpenoids, and diterpene alcohols. Juvekar and Halad (2006) investigate the flower of *Cassia Auriculata* L. extract contains antroquinon, aloe emoden and sistosteral.

1.5 OPERATIONAL DEFINITIONS

**Anthropometry:** Antropometry (anthropos = man; metry= measure) is a science which developed for the purpose of understanding human physical variation; it refers to systematic quantitative representation of the human body, specifically employing measurements of physical dimensions of living individuals and also human remains. In the present context anthropometery refers to height, weight, body mass index, BCA (Body Composition Analysis)

**Diabetes Mellitus:** According to World Health Organization (2006) Diabetes Mellitus is as a metabolic abnormality characterized by hyperglycemia and disturbances of carbohydrate, fat and protein metabolism. There are associated with absolute or relative deficiency in insulin secretion and/or insulin action Diabetes Mellitus is defined as a metabolic abnormality characterized by hyperglycemia and disturbances of carbohydrate, fat and protein metabolism that are associated with absolute or relative deficiency in insulin secretion and/or insulin action.
**Type 2 Diabetes:** Formerly named non-insulin-dependent, which results from the body's inability to respond properly to the action of insulin produced by the pancreas. Type 2 diabetes is much more common and accounts for around 90% of all diabetes cases worldwide. It occurs most frequently in adults, but is being noted increasingly in adolescents as well. In the present study random blood glucose level $>200$ mg/dl, HbA1c $>7$ was taken in consideration. (WHO, World Diabetes Day 2014)

**Pre-diabetic:** Clinical practice guidelines have defined pre-diabetes as either impaired fasting glucose (IFG) (fasting plasma glucose [FPG] of 100–125 mg/dl) or impaired glucose tolerance (IGT) (glucose of 140–199 mg/dl on a 2-h oral glucose tolerance test [OGTT]). (Mann et al, 2010)

**Body Composition:** In the context of preceding refers to relative proportion of lean body mass (LBM) and body fat mass (BFM) within the body. In the present study the following parameters were used.

**Body Fat Percentage:** In the present study, body fat percentage ranges from $<21$ as low, 21.0-32.9 as normal, 33.0-38.9 as high and $>39.0$ as very high. Fat located under the skin (subcutaneous), between the muscles (intramuscular) and around internal organs (visceral), this tissue serves to provide insulation against heat/cold, protective padding, energy and nutrient stores and proper functioning of hormonal and immune systems. Body Fat Percentage is a measure of the amount of body fat as a proportion to total body weight

**Visceral Fat:** Visceral fat are the deep underlying fat stores located around the internal organs of the abdomen (www.sportstek.net). In the present context visceral fat varies from normal ($<9$) to very high ($>15$).
**Fat-Free Mass:** Fat-free mass is comprised of the non-fat components of the human body. Skeletal muscle, bone and water are all examples of fat-free mass.

**Skeletal Muscle:** Skeletal muscle is the muscle attached to the bones of the body to create movement. Skeletal muscle mass can be increased with exercise which may be desirable in changing the body composition and reducing body fat levels.

**Muscle Mass:** Muscle mass is the total weight (or percent by weight) of muscle tissue in the body. While fat essentially stores calories for use by the body, muscles burn calories in order to function. This means that higher muscle mass increases the ability to burn more calories. In the present study body composition analyser was used to calculate the muscle mass and accordingly it ranges from low, normal, high and very high (<24.3, 24.4-30.3, 30.4-35.3 and >35.4) respectively.

**Bone Mass:** In the present study, the normal bone density is within 1SD (+1 or -1) as per the recommendation World Health Organisation (WHO). Bone mass is the total amount of bone tissue in the skeleton. Body Density is the volume of calcium and minerals within the bone tissue.

**Total Body Water:** In the human body, water is essential for the digestion of food, the transport of nutrients to the tissues, elimination of body wastes, circulation of blood and lymph fluids, as a lubricant in the joints and internal organs, and for regulation of body temperature. Total body water varies with sex, weight, and age and in general tends to decrease as we aged. In the present context, average body water for female range from 45 to 60 percent.
**Basal Metabolic Rate:** The average BMR or Basal metabolic rate referred in the present study was 1300-1500. The BMR is the amount of energy expended while at rest in a neutrally temperate environment, in the post-absorptive state. The release of energy in this state is sufficient only for the functioning of the vital organs, such as the heart, lungs, brain and the rest of the nervous system, liver, kidneys, sex organs, muscles and skin.

**Metabolic Age/Body Age:** Metabolic age is a reflection of physical health in the form of a calculation based on the base metabolic rate (BMR). If someone’s metabolic age is lower than his or her actual age, it suggests that the body is in good health, while a metabolic age higher than the actual age indicates that someone may be experiencing health problems. This measurement is one among many which can be used to assess health, and people should avoid putting too much weight on it.

**Body Mass Index:** BMI is a simple calculation to determine a person’s height to weight ratio. This method provides a slightly more accurate representation of the body composition than weighing alone. In the present study, as per WHO recommended Asian standards for BMI ranges from severe underweight (<14.9), underweight (15.0-18.4), normal SS (18.5-22.9), overweight (23.0-27.5), grade I obesity (27.6-40) and grade II obese (>40.0).

**Obesity:** Obesity is body weight more than 20 percent above the desirable weight due to fat deposition whereas overweight is body weight more than 10 percent above the desirable weight may be to due to muscle development (*Bennion M, 1979*). In the present context, obesity screening was based on Body Mass Index (BMI - > 22.9) as per the WHO Asian standards.
**Glycemic Index:** Glycemic Index (GI): a measure that ranks foods on the basis of the blood glucose response that they produce upon ingestion relative to the response of a reference glucose solution or white bread with the same carbohydrate portion *Minna (2012).*

**Glycemic Load:** Glycemic load (GL) takes into account the amount of carbohydrates consumed in addition to GI *Minna (2012).*

**Sensory Evaluation:** Sensory evaluation is defined as the scientific discipline used to evoke, measure, analyze and interpret reactions to characteristics of food as perceived through the senses of sight, smell, taste, touch and hearing. In this study context the organoleptic evaluation is referred as four point hedonic rating scale (poor to excellent) used to measure the taste, texture, appearance, consistency and colour of selected recipes.

**In Vivo:** In vivo refers to a medical test, experiment or procedure that is done on a living organism, such as a laboratory animal or human. [http://lungcancer.about.com/od/glossary/g/invivo.htm](http://lungcancer.about.com/od/glossary/g/invivo.htm)

### 1.6 OBJECTIVES OF THE STUDY

**Field Study:**
- To delineate the socio demographic, anthropometric, dietary and health profile of the of type 2 diabetic subjects.
- To evolve a conceptual model highlighting the socio economic & health attributes leading to prevalence of T2D

**Experimental Studies:**
- To study the nutritional & pharmacological properties of *Pisonia grandis R.Br.* leaves.
- In vivo study to analyze the anti-diabetic activity of *Pisonia grandis R.Br.* leaves.
To develop the recipes using *Pisonia grandis* R.Br leaves and evaluate organoleptically the standardized recipes.

To assess the insulin secretion in a normal subject after administering *Pisonia grandis* R.Br. leaf soup – A Case Study.

1.7 Flow Chart depicting the Methodology adopted for the entire study (Figure-1).

1.8 LIMITATION OF THE STUDY

The study was limited due to time and financial constraint which, if had not been there, the study could have been extended for further analysis.

1.9 PLAN OF THE THESIS

The research volume will consist of eight main chapters placed in a sequential order namely,

1. **Introduction:** This Chapter discusses the prevalence of diabetes and the modifiable risk factors associated with the same. It also states the problem and highlights the need to address the issue. The Chapter also covers the objectives, operational definitions and the limitations of the study and the flow chart depicting the methodology used for the entire study.

2. **Review of Literature:** Emphasis on the prevalence of type 2 diabetes at global, Asian, Indian and at Puducherry level. The chapter also points the socio-cultural determinants, the metabolic changes associated with the development of the disorder, the various genes involved and the various therapies used to treat the diabetes. This part also covers the list of herbs which have the anti-diabetic activity and its importance on diabetes and as well as highlights the details on glycemic index and insulin index.
3. **Prevalence of Type 2 Diabetes (T2D) among Puducherrians:**
   The results obtained in community survey are discussed at length in this chapter. This fulfils the Objective 1 & 2 of the study viz. To delineate the socio demographic, anthropometric, dietary and health profile of the type 2 diabetic subjects. Further, this Chapter reveals the study with mean and standard deviation values. In addition, the results are also highlighted statistically according to the different phases of the study in sequential manners. The different variables used in the study are also correlated and tabulated with description and a conceptual model is evolved.

4. **Nutritional and Pharmacological properties of *Pisonia grandis* R.Br. Leaves:** The chapter deals with the Nutritional and Pharmacological properties of *Pisonia grandis* R.Br. leaves. This fulfils the Objective 3 of the study viz. “To study the nutritional & pharmacological properties of *Pisonia grandis* R.Br. leaves”. Further, this chapter reveals the Phyto-constituent present in the *Pisonia grandis* R.br. leaves by using High Pressure Thin Layer Chromatography (HPTLC) and Gas Chromatography & Mass Spectrometry (GCMS)

5. **Anti-diabetic activity of *Pisonia Grandis* R.Br. leaves:** This chapter broadly explains the anti-diabetic activity of *Pisonia grandis* R.Br. in two phases of experimental study viz. Anti-Diabetic Activity of *Pisonia Grandis* R.Br. leaves against Streptozotocin (STZ) induced diabetes mellitus in rats and Anti-diabetic activity of the *Pisonia grandis* R. Br leaves in human subjects. This fulfils the Objective 4 of the study viz. “In vivo study to analyze the anti-diabetic activity of *Pisonia grandis* R.Br. leaves”.
6. **Standardization of South Indian recipes incorporated with *Pisonia grandis R.Br.* fresh leaves:** The results were obtained in Standardization of South Indian recipes incorporated with *Pisonia grandis R.Br.* fresh leaves which are discussed at length in this chapter. This fulfils the Objective 5 of the study viz. “To develop the recipes using *Pisonia grandis R.Br* leaves and evaluate organoleptically the standardized recipes”.

7. **Insulin secretion in a normal subject after administering *Pisonia grandis R.Br.* leaf soup – A Case Study:** The results obtained in insulin levels of normal individual before and after administering *Pisonia grandis R.br.* leaf powder of 200 ml of soup is discussed at length in this chapter. This fulfils the Objective 6 of the study viz. To assess the insulin secretion in a normal subject after administering *Pisonia grandis R.Br.* leaf soup – A Case Study.

8. **Summary and Conclusion:** Briefs about the study in whole starting from the introduction to review and the methodology in a crisp manner. The significant results and the outcome of the study is the main focus of this chapter. This last chapter of the thesis also gives a conclusion along with suggestions for future research.