Chapter 1
INTRODUCTION

1.1 Diabetes

Diabetes is a chronic disorder, having a cluster of metabolic disorders distinguished by high blood sugar (hyperglycemia), followed by excess thirst, fatigue, polyphagia, polydipsia, polyuria, hunger and weight loss (WHO, 2008).

It leads to the advancement of microvascular and macrovascular complications. The key roles of free radical, stress and vascular complications of this disease are well essayed. Diabetes claims the maximum number of deaths and is well known for the second most common reason of casualty after cancer.

The Diabetes atlas indicates that India, China and the United States would gain top three places in 2025. The prevalence of diabetes and its associated complications have raised quickly from 135 million in 1995 to an estimated 380 million in 2025 (Ali, 2011).

Diabetes is characterized majorly in two types. Type 2 diabetes mellitus (T2DM) is more pandemic than type I and continued to increase worldwide, affecting about 370 million people and causing 4.6 million deaths every year (AAS, 2010).

The higher amounts of glycated hemoglobin (HbA1c) indicates the deprived control of blood glucose levels. It is known to be associated with several other complications such as cardiovascular disease, nephropathy and retinopathy.

The American Diabetes Association recommends using either HbA1c levels (5.7%–6.4%) or the old fasting plasma glucose (FPG) (100–125 mg/dL) or the oral glucose tolerance test (140–199 mg/dL) criteria to define pre-diabetes. The World Health Organization (WHO) also indicates and recommends an HbA1c level ≥6.5% as a major phenomenon to “Know your Diabetes level” (Kowall and Rathmann, 2013).

1.2 Oxidative Stress

Oxidative Stress is known to have a unifying link between diabetes mellitus and its complications such as CVD and loss of immune potency. This is a known fact that free radical induced damage is responsible for appendage dysfunction. In all aerobic living beings, alteration of oxygen to free radicals like Oxygen free radical (O_2^-), Hydroxyl ion (OH^-), Hydrogen peroxide (H_2O_2) (all are reactive oxygen species (ROS)), happens as a component of usual metabolism. In a healthy person, the balance of ROS generation and ROS elimination happens. In a case of ailment, an in-balance would occur, that increases free radicals, thereby increasing the oxidative stress (da Silva et al., 2010).

1.3 Antioxidants

Antioxidants are the molecules capable of maintaining a delicate equilibrium between the rate of generation and the rate of neutralization of free radicals, thereby maintaining a steady state (Salman, 2010). In the process of neutralizing free radical molecules to a non free radical molecule, antioxidants themselves get converted to a free radical. However, the converted free radicals are less reactive than ROS and Reactive Nitrogen Species (RNS) (Berthoud and Beyar, 2009).

1.4 Botanicals in Dietary Supplements

“Let food be thy medicine and medicine be thy food” was the famous dictum proclaimed by Hippocrates about 2500 years ago.

Phytochemicals are used as an alternate medicine in Ayurveda, the Indian traditional medicine. Major classes of phytonutrients that have potential health benefits include carotenoids, polyphenols, isothiocyanates, sulfides and phytosterols. These natural compounds appear to have multiple biological functions, ranging from antioxidants to anticancer. There is an increasing interest in the use of plant derived bioactive molecules for therapeutic purpose. Advancement in technology to assist the process of isolation, identification and screening of bioactive molecules towards various functional properties has also triggered the research in the field of bioactive molecules. Another fascinating observation is that, bioactive molecules produced in plant systems not only provide health benefits to humans, many of these bioactive molecules are reported to affect the normal

functioning of the source system where they are produced. Study on these aspects formed a new branch of science called 'Teleology', a 'doctrine explaining phenomena by their ends or purposes', which gives information about 'Why it exists? What is its role?'. Studies of teleology of bioactive molecule information about the functional truth are following its existence in that system.

1.5 Natural Products for the Treatment of Type 2 Diabetes

Diabetes is prompted by several factors like insulin resistance, physical inactivity changes in dietary habits, modern life style and smoking. There are several synthetic drugs currently available in the market that give rise to several side effects such as hyperlipidemia / hypercholesterolemia, obesity and atherosclerosis. The above mentioned side effects prompt scientists to think of an alternative or substitution in dietary as well as natural products. Therefore, a natural therapy indicates prospect for the pharmacological administration of this metabolic disorder due to their multi-receptor actions. So there is great demand to search a new alterative therapy to diabetes. A WHO report (2008) indicated that approximately 60 -70% world population rely on Complementary and Alternative Medicines (CAM) for their principal wellbeing. Therefore, CAM therapy such as acupuncture, Unani, Siddha, herbal medicines and moxibustion are gaining interest for diabetes and other ailments.

1.6 CAM, Oxidative Stress and Antioxidant Compounds

Momordica charantia, Aegle marmelos, Gymnema sylvestre, Syzium cummni, Trigonella foenum graecum, Curcuma longa, Allium cepa, Punica granatum and Ceasalpinia crista are the most known herbs for the diabetic treatment (Patel et al., 2012). Ellagic acid is known polyphenol in berries and has many properties like antioxidant and antimicrobial (Middha et al., 2014).

Several plant derived compounds have shown to activate glucose transport pathway through different herbal extracts by AMP Activated Protein Kinase activation such as curcumin, a principal curcuminoid of turmeric, salidroside, a bioactive component from Rhodiola rosea (Ong et al., 2011). Cryptotanshinone was also stated to have AMP Activated Protein Kinase mediated stimulatory effect on glucose

uptake in adipocytes and muscles (Poulose et al., 2011).

1.5 Bamboo

Bamboo, represented by about 1575 species belongs to the subfamily Bambusoideae of the true grass family Poaceae (Goyal and Sen, 2015; 2016). Bamboo is naturally distributed throughout the globe. With about 136 indigenous and exotic species that grow naturally and/or under cultivation. India is one among the richest countries in bamboo resources (Basumatary et al., 2017a). Bamboo continues to play a key role in the lifestyle and economy of Asian countries due to its multifarious uses and a large part of society still heavily relies on it (Brahma et al., 2014; Basumatary et al., 2017b).

From ancient time bamboo has been an important ingredient of traditional Asian Medicines in general and Chinese medicine in particular (Brahma and Goyal, 2014). Modern scientific approaches are now used to validate the traditional uses and researchers from round the globe have been successful in isolating active chemical constituents from different parts of this green gold (Brahma and Goyal, 2014).

1.5.1 Bambusa tulda Roxb.

Bambusa tulda popularly known as Owa Gubwai (*Bodo*) or Jati Banh (*Assamese*) (Brahma et al., 2014) is considered to be one of the most useful of bamboo species. It is used extensively by the paper pulp industry in India. It can grow up to height of 17

Botanically, *Bambusa tulda* is classified as under (https://plants.usda.gov/java/)

Rank	Scientific Name
Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Liliopsida
Subclass	Commelinidae
Order	Cyperales
Family	Poaceae/Gramineae
Sub-family	Bambusoideae
Genus	*Bambusa* Schreb.
Species	*Bambusa tulda* Roxb.

m and a thickness of 16.5 cm (Basumatary et al., 2017b). It is commonly found in southeastern Asia. In India, it is endemic to North Eastern parts of the country and West Bengal.

Survey of scientific literature revealed that the experimental evidence on the traditional use of this plant is not yet documented. Only a few studies have been conducted to ascertain the anti-diabetic effect of bamboo (Senthilkumar et al., 2011; Nam et al., 2013; Sangeetha et al. , 2015; Menaria, 2016; Goyal et al., 2017).

Keeping this in view, the present study entitled "A study on Antioxidant Property and Therapeutic Potential of *Bambusa tulda* leaf found in Kokrajhar District, BTAD, Assam" might be the first one to focus on the following objectives

1. To understand the phytochemical and *in vitro* antioxidant properties of different fractions of *Bambusa tulda* leaf.

2. To evaluate anti-diabetic activity of *Bambusa tulda* leaf on diabetic male wistar rats.

3. To determine antioxidant enhancing capacity of *Bambusa tulda* leaf extracts in Alloxan/streptozotocin induced diabetic rats by measuring the activity of antioxidant enzymes such as superoxide dismutase and glutathione peroxidase.

4. To assess antiperoxidative and antioxidative efficacy of *Bambusa tulda* leaf by estimating the concentration of malondialdehyde and protein carbonyl content, a biomarker of lipid peroxidation.

5. To understand the effect of *Bambusa tulda* leaf by histopathological evaluation of pancreas on diabetes by comparing experimental diabetic rats with the insulin and Glibenclamide treated rats.