Chapter 2
Application of Some Medicinal Plants and Their Constituents in the Treatment of Diabetes Mellitus

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ABSTRACT

The rapidly increasing incidence of diabetes mellitus as a chronic disease is becoming a serious threat to mankind health in all parts of the world. However, the currently available therapies are not of much use in prevention or reduction of disease. There are a large number of plants and natural biomolecules that have been discussed in the literature for their antidiabetic effects. Recently, the screening of many types of plant derived alpha-amylase, alpha-glucosidase inhibitors and other compounds that reduce the glucose level in the body and have fewer side effects has been successfully isolated. In this chapter, the mechanism of diabetes mellitus has been discussed. Also, the plants having anti-diabetic property along with its constituents has been presented summarized with the available literature resource. In addition to this, the common strategy that is followed for inhibition assay for an anti-diabetic compound has been discussed. Finally, future opportunities and challenges in this research area are proposed.

INTRODUCTION

Diabetes mellitus commonly known as diabetes, is a metabolic disorder characterized by enhanced blood glucose level due to inadequate amount of insulin hormone secretion from the pancreatic gland (Owolabi et al., 2014). The rapid increase in the numbers of diabetes patients throughout the globe is a great concern in recent times. As per a recent report, about 177 million of the global population live with diabetes and this figure is more likely to increase by 2030 (World Health Organisation, 2000; Ndarubu et al., 2019). Considering the severity of the disease, the diabetes mellitus, is considered as one of the

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five leading causes of death in the world, also it affects the carbohydrate, fat, and protein metabolism and ultimately causes the disorder. A worldwide survey report says that the disease spreads progressively, that affects nearly 10% of the population in each year (Venkatachalam et al., 2017). If left untreated, diabetes mellitus can cause many more complications such as diabetic ketoacidosis and non-ketotic hyperosmolar coma (Kitabchi et al., 2009). Therapeutic point of view, the available synthetic drugs are associated with a large number of side effects, therefore continuous taking these medicine can create side effects. Therefore, the drugs that are of plant origin are preferred as it is associated with less or no side effects, hence increasing attention for all (Monday et al.,2013). Fortunately, so many of the plant extract has shown their significant anti-diabetic properties with more efficacy than oral hypoglycaemic agents that are currently used in clinical therapeutics. Several categories of diverse plant products are available called as antidiabetic *active compounds* used as alternatives for the treatment of diabetes. One of the basic mechanism of treating the disease is carbohydrate absorption in the body after food intake is to be reduced in case of diabetes patients. The theory behind the mechanism is that the complex polysaccharides are broken down to simpler form such as glucose and fructose (monosaccharide) by the enteric enzymes, like pancreatic α-amylase and α-glucosidases. Then these monosaccharides transported from the intestinal lumen to the bloodstream, thereby increasing the sugar level. Hence finding suitable inhibitor compounds (hypoglycemic agents) to the above enzymes is essential for the treatment of diabetes patient. Currently, most commonly practised treatment methods include different oral hypoglycaemic agents described in the below section (Gallaghe et al., 2015; Ortiz-Andrade RR et al., 2007).

Throughout the world, attempts have been made to discover as well as to isolate potential phytoconstituents from the plants those having a broader range of biological activities (Bailey & Day, 1989). However, the details about the major categories of phytochemicals responsible for the antidiabetic activity has not been studied so far. Hence, there exists a great opportunity to search for new antidiabetic drugs from plant-based natural compounds such as glycosides, alkaloids, terpenoids, flavonoids, carotenoids that exhibit anti-diabetic effect (Ahmad et al., 2003). The easy availability of the plant resources, least side effects and low cost of making the herbal medicine preparations can make the plant-based medicine as the key player of all available therapies against diabetes mellitus. As every plant has a natural habitat and, are restricted to particular areas on the globe so the preliminary requirement is for exploring the antidiabetic potentials of unexplored plants as well (Malviya et al., 2010; Bashir et al., 2015). In the traditional mode of practising the medicinal plants to control diabetes mellitus, many countries use the ethnobotanical information that reports about 800 documented plants worldwide and can be used for beneficial effects in the treatment of diabetes. These traditional antidiabetic plants require the proper scientific and medical evaluation for their ability to improve blood glucose control. However, a few comprehensive studies on traditional antidiabetic plants have been carried out, that causes an increase in the number of experimental and clinical investigations directed toward the validation of the antidiabetic properties, which are empirically attributed to these remedies. The antidiabetic activity of several plants has been confirmed along with their studies of mechanisms of hypoglycemic activity. Chemical studies directed to the isolation, purification and identification of the substances responsible for the hypoglycemic activity have also been conducted (Malviya et al., 2010; Kaur et al., 2013; Patil et al., 2014; Roman-Ramos et al, 1995; Sonkamble & Kamble 2015).

In this chapter, the basic aspects of some of the potential anti-diabetic plants, their available therapeutic molecules and the extraction process will be discussed by narrating the literature.