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A Review on Effects of Black Nightshade (Solanum Nigrum)- Phenolics on Key Enzymes Linked with Type-II Diabetes

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Abstract: *A traditional edible plant Solanum nigrum Linn. (commonly known as black nightshade) has a wide variety of therapeutic activities. Ethanolic extract of the leaf is effective on significant reduction in treatment of reducing blood sugar level. It inhibited α- amylase, α- glucosidase which are directly related to Type- II Diabetes Mellitus (DM). The major active components are glycoalkaloids, glycoproteins, and polysaccharides. It also contains polyphenolic compounds such as gallic acid, catechin, protocatechuic acid, caffeic acid, epicatechin. The beneficial effect against DM of black nightshade leaf extract as inhibitor of type II diabetes by consuming as daily or frequent intake in the form of natural food.*

Keywords: *Type II DM, therapeutic, phenolics*

1. Introduction

Diabetes Mellitus (DM) is a chronic metabolic disorder marked by persistent hyperglycemia caused either by impaired insulin secretion or impaired insulin action or both. It is among the most common global health concerns, with increasing rates of incidence in both developed and developing countries. Type I Diabetes Mellitus (T1DM) and Type II Diabetes Mellitus (T2DM) are of two kinds of diabetes diseases, which differ in pathophysiology, and treatments. T1DM is an autoimmune disease that causes the destruction of pancreatic beta cells, resulting in an absolute deficiency of insulin, whereas T2DM is mainly characterized by insulin resistance and relative deficiency of insulin.

The burden of diabetes worldwide is enormous, and the World Health Organization estimates that more than 400 million people are suffering from this disease. This number is expected to rise significantly in the coming decades due to factors such as aging populations, urbanization, and lifestyle changes. Complications arising from poorly managed diabetes include cardiovascular disease, kidney failure, neuropathy, and retinopathy, all of which significantly impact the quality of life and lead to increased healthcare costs. Furthermore, studies lately brought to the limelight factors including genetic, environmental, and lifestyle as potential predisposing and modifying influences both in the causation of diabetes and in the disease course.

Solanum nigrum (black nightshade) of Solanaceae is of profound ethnomedicinal importance being used traditionally to treat various ailments such as pain, inflammation and fever (Acharya and Pokhrel, 2006). It is known as an anti-inflammatory, diuretic and antipyretic agent (Zakaria *et al*., 2006) and as an antitumorigenic and antioxidant (Lee and Lim, 2003). Various hepatoprotective compounds have been isolated from it (Raju *et al*., 2003). Although this plant is widely used in many traditional systems of medicine worldwide (Jain *et al*., 2011), It usually grows as a ruderal as well as an agrestal weed and can also be cultivated in tropical and subtropical agro climatic regions. The species can also be used for reclaiming the degraded land (Kiran *et al*., 2009).

2. Review of Literature

Plants have always been an excellent source of drugs and most of the medicines available today have been obtained either directly or indirectly from them. The ethnobotanical data indicate that around 800 plants could have antidiabetic activity. Several such herbs have demonstrated anti-diabetic activity while evaluated using different type of experimental techniques. A vast array of plant derived phytoconstituents representing different type of biological activity, among these alkaloids, glycosides, polysaccharides, peptidoglycans, steroids, polyphenols, carbohydrates, glycopeptides, terpenoids, amino acids and inorganic ions have shown activity including treatment of diabetes in a dose dependent manner. (KO et al., 2007). Generally, two carbohydrate hydrolyzing enzymes α-amylase and α-

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glucosidase are responsible for the postprandial hyperglycemia. α-amylase initiates carbohydrate digestion through hydrolysis of 1, 4-glycosidic linkages of polysaccharides (starch, glycogen) into disaccharides, while α-glucosidase catalyzes disaccharides to monosaccharides, which subsequently results in postprandial hyperglycemia. (Mishra et al., 2010). Thus, inhibitors of α-amylase and α-glucosidase can be beneficial in hyperglycemia control, since delay in carbohydrate digestion that reduces plasma glucose postprandial hyperglycemia.

Inhibitors of α-amylase and α-glucosidase from food grain plant sources offer an attractive therapeutic approach to the treatment of post-prandial hyperglycemia by decreasing glucose released from starch and delaying carbohydrate absorption in the small intestine and may have potential for use in the treatment of diabetes mellitus and obesity (Gallahar and Schneeman,1986; Murai *et al*.,2002). Food grain phenolic α-amylases inhibitors from dietary plant extracts are potentially safer and therefore may be a preferred alternative for modulation of carbohydrate digestion and control of glycemic index of food products (Mccue *et al.*, 2005).

Current scientific evidence demonstrates that much of the morbidity and mortality of diabetes can be eliminated by aggressive treatment with controlled diet, exercise and new pharmacological approaches to achieve better control of blood glucose level. The possibility of preventing the onset of diabetes using dietary supplements and/or herbal medicines has attracted increasing attention (Asano, 2003).

Twenty-one naturally occurring flavonoids were tested for inhibitory activities against alpha-glucosidase and alpha-amylase by Kim *et al*.(2000). Luteolin, amentoflavone, luteolin 7-O-glucoside, and daidzein were the strongest inhibitors among the compounds tested. Luteolin inhibited alpha-glucosidase by 36% at the concentration of 0.5 mg/ml and was stronger than acarbose, the most widely prescribed drug, in inhibitory potency, suggesting that it has the possibility to effectively suppress postprandial hyperglycemia in patients with non-insulin dependent diabetes mellitus. Luteolin also inhibited alpha-amylase effectively although it was less potent than acarbose. The clinical value of luteolin needs to be further evaluated (Kim *et al.*,2000).

In a review on antidiabetic plant Prabhakar and Dobley (2008), have shown that there are around 410 experimentally proven medicinal plants having antidiabetic properties but the complete mechanism of action is available only for about 109. There are several medicinal plants whose extract modulate glycolysis, Krebs cycle, gluconeogenesis, HMP shunt pathway, glycogen synthesis and their degradation, cholesterol synthesis, metabolism and absorption of carbohydrates, and synthesis and release of insulin. The work of these authors provides a comprehensive idea about the mode of action of medicinal plants that exhibit anti-diabetic properties.

Efforts of scientists have proved that enzyme mechanism-based inhibitors could be developed into highly selective drugs. Since many enzymes inhibitory drugs show potent side effects and toxicity (Orhan *et al.*, 2004) research in the field of searching natural enzyme inhibitors is always in demand. The best sources of such natural enzyme inhibitors are the secondary metabolites, especially the phenolics, of plants.

Solanum nigrum has been explored for its nutraceutical potential in a wide array of health foods and drinks (Jairajpuri and Qadri 2015). The extract had significant antidiabetic activities Supports the findings of earlier researches of antidiabetic activity of ethanolic extract of *Solanum nigrum* (Tiwari and Jain, 2012). In another study, leaves extract, showed significant anti-hyperglycaemic and Hypolipidemic effects (Poongothai et al.,2010). However, little is known about the mechanism of action, active ingredients. Present or safety of these treatments in diabetic and healthy individuals. Phenolic compounds from eggplant (Solanum *melongena*) were seen by (Kwon, 2008) to possess strong inhibitory action against α-amylase and α-glucosidase which are related to Type-2 Diabetes mellitus. *S. nigrum* is another allied species which possesses various compounds that are responsible for diverse activities.

4. Conclusions

Solanum nigrum has been explored for its therapeutic potential in a wide array of health foods and drinks. However, little is known about the mechanism of action, active ingredients present or safety of these treatments in diabetic and healthy individuals. Further studies on mechanism of action and methods of safe and biologically active delivery will help develop an anti-diabetic oral protein drug from these plants. It is a necessity to develop an anti-diabetic oral protein drug from this natural source as it does not have side effects. We shall explore new therapies: pharmacological interventions, lifestyle adjustments, and emerging technologies, aimed at improving the quality of life for diabetic patients and reducing the management burden associated with the disease. It is our belief that synthesis of present studies will enable this paper to contribute towards ongoing efforts in the quest to combat this global health threat.

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