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Effects Of Phytochemicals on Type 2 Diabetes Mellitus -A Short Review

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Abstract

Diabetes mellitus (DM) is the most prominent cause of mortality globally. It is a severe metabolic disorder marked by high blood glucose levels and insufficient insulin generation and activity. Type 2 Diabetes Mellitus (T2DM) prevalence has risen dramatically due to population aging, obesity, and modern lifestyles. T2DM is distinguished by impaired beta pancreatic cell function and insulin production. Numerous studies have found that diabetes mellitus is related to increased free radical production and decreased antioxidant potential. Phytochemicals are essential in improving insulin sensitivity, which has free radical scavenging and antioxidant properties. Several phytoactive compounds, such as flavonoids, prophenylphenols, vicine, charantin, lignans, glycosides, and karavilosides, are also found to combat the complications of diabetes. The primary focus of this research will be the connection between T2DM and the preventative roles of several phytochemicals on diabetes through their antioxidant characteristics. These phytochemicals and photo sources may be employed to discover and create novel anti-diabetic medicines.

Keywords: *Diabetes, Phytochemicals, Type 2 diabetes mellitus, Moringa Oleifera, Hyperglycaemia, Functional Food, Diabetes complications.*

1. Introduction:

An insufficient level of insulin activity or secretion is a characteristic of diabetes mellitus, a chronic metabolic disorder (Kharroubi, 2015). Lack of insulin, an anabolic hormone, can cause abnormalities in protein, carbohydrate, and lipid metabolism.There are many causes of abnormal metabolism, including insulin resistance in target tissues,insulin deficiency, insulin receptor levels, adipose tissues, and skeletal muscles in particular, as well as the liver. The signal transduction system, effector enzymes, and genes, as well as the signal transduction pathways, are also contributing factors (Hunter, 1998).It has been estimated that about 2.8% of the world's population has diabetes as a chronic metabolic disease, and the number is expected to reach 4.4% by 2030, indicating that the degree of the epidemic has already reached unprecedented heights (Wild, 2004).The world's top five biggest morbidities are largely attributable to diabetes, despite its non-communicable nature (Kharroubi, 2015).According to the severity of the symptoms, diabetes categories and frequencies vary. Asymptomatic diabetes patients, particularly those suffering from type 2 diabetes during the early stages of illness, are more prevalent than hyperglycemic patients. A diabetic with uncontrolled and unmonitored diabetes can develop ketoacidosis, or a rare disorder of hyperosmolar

blood pressure that can even cause death if left untreated (American Diabetes Association, 2014). Diabetes development may include genetic and non-genetic factors. Non-genetic factors can include lifestyle choices such as diet, lack of exercise, obesity, and smoking. Additionally, environmental factors can also play a role in the development of diabetes. Exposure to certain chemicals and pollutants may increase the risk of diabetes, as well as stress and chronic inflammation. Age and family history of diabetes may also contribute to a person's risk (Patel, 2012). It is still considered the most accurate and widely accepted classification of diabetes by the American Diabetes Association (ADA) as type 1, type 2 and gestational diabetes mellitus (GDM).It is crucial to classify diabetics and treat them accordingly, but classification is a bit ambiguous (Cakan, 2012). Many diabetic patients are not easily categorized into one class, especially younger adults, and up to 10% of the initially classified patients may have to be revised (American Diabetes Association,2014).

Diabetes and cardiovascular diseases are chronic diseases associated with obesity and diet play an important role in their etiology and prevention. It has been shown that eating more vegetables, fruits, and whole grains reduces the risk of type 2 diabetes (Van Dam ,2002). Although the health effects of plant-based diets have been limited, phytochemicals, a large class of nonnutrient secondary metabolites in plants that give fresh or processed fruits and vegetables much of their colour and taste, have been found to play a significant role.It is known that phytochemicals, such as polyphenols or carotenoids, may have antioxidant properties, but it is less clear how phytochemicals may protect type 2 diabetics from other biochemical mechanisms.Several studies have shown that curcumin reduces insulin resistance, hyperglycemia, and hyperlipidemia, and prevents diabetes-related complications (Marton, 2021). Garlic contains bioactive compounds such as allicin, alliin, diallyl sulfide, allyl-cysteine, etc. Type-2 diabetes can be reduced by taking these supplements (Sanie-Jahromi, 2023). Several active phytochemicals in mushrooms show high effectiveness in treating diabetes mellitus, including Comatin, beta-glucan, Tremellastin, and Lentinan KS-2 (Aramabašić Jovanović, 2021). Moringa Oleifera has Quercetin, an antioxidant that lowers blood sugar levels (Mthiyane, 2022).

Diabetes has become a global health concern nowadays. Diabetes burden between 1995 and 2025 was studied in 195 countries as part of the global burden of disease study. Among people with incident diabetes between 1990 and 2017, the numbers increased from 11.32 to 22.90 million (by 129.7%). The spices in this case act as antioxidants, which balance insulin glucagon secretions from the pancreas, thereby preventing T2DM. Therefore, the goal is to gather some information on some spices, herbs, and plant substances that are effective in boosting immunity and curing T2DM.

2. Effects of Phytochemicals in Diabetes Mellitus and Their Symptoms:

2.2.1 Cosmosin :

Cosmosiin a flavonoids which is known as apigetrin or apigenin-7-O-glucoside, is a glycosyloxyflavone that is found in various variety of citrus plants, such as *Citrus grandis* (L.) Osbeck (red wendun) and Citrus aurantium Linn. of the Rutaceae species. It is also noted that, cosmosiin and its species have been suggested for anti- diabetic therapies (Munhoz, 2018). Rao et

al. suggested that The antidiabetic effect of cosmosiin in their test-tube study using the adipocyte cells named 3T3-L1. Cosmosiin endeavour its curative effects through promoting the secretion of adiponectin, that results in raised the amount of insulin receptor β (IR-β) phosphorylation. By beside, it also had a vital effect on translocation of glucose transporter 4 (GLUT4) (Rao, 2011). Therefore, these consequences suggest that cosmosiin has anti-diabetic activity, which leads an important role in stimulation of glucose uptake into body muscles and adipocytes. So, it can be suggested that this compound could be favourable for the treatment of type 2 diabetes mellitus and it's difficulties.

2.2.2 Diosmin:

A flavone group phytocompound Diosmin that is found in citrus fruits and the orange and lemon leaves. Diosmin's has some important biological activities, such as antioxidant activity, anti-inflammatory activity, and anti-apoptotic effects has some important beneficial role on diabetes mellitus (Shalkami, 2018). Diosmin was isolated for the first time in the year 1925 from Scrophularia nodosa Linn. (a perennial herbaceous plant from the family Scrophulariaceae) diosmin was first time isolated and applied for the first time in 1969 as an anti-inflammatory agent in inflammation disorders (Bogucka-Kocka, 2013). It is also reported that, it is a biochemical markers like fasting plasma glucose concentrations, glycosylated hemoglobin (HbA1c), and C-reactive protein (CRP) (Jain, 2014).

2.2.3 Sudachitin:

Sudachitin,a menthocubanone is found in the skin of Citrus sudachi Hort Fruit (Nakagawa,H.,2006). This polymethoxylated flavone has the effects on carbohydrate, fat and energy metabolism. This flavone has the ability to modulate those genes which are related to metabolisms. It helps in GLUT4 (Glucose Transporter 4) expression by regulating the mRNA. It also leads a role in transcription of uncoupling protein 1 and 3 (UCP1 and UCP3) (Tsutsumi, 2014).

2.2.4 Tangeretin:

It is notified that Tangeretin normalize the amount of glycogen level and remarkably leads a vital role in reforming the pancreatic beta cells in the islets of Langerhans (Sundaran, 2014). It is an O- polymethoxylated flavone which has anti-diabetic, anti-inflammatory, anti-cancerous potential (Ashrafizadeb, 2020). Tangeretin has anti-hyperglycemic activity as it has the potential activities with enzymes that are co-related with carbohydrate and glycogen metabolism (Sundaran, 2014). Tangeretin has an effect on oxidative stress produced by glucose and accumulation in extracellular matrix (ECM) in human glomerular mesangial cells (HGMCs). As a curative property it reduces the risk of diabetic nephropathy, which is the leading cause of morbidity and mortality of diabetes and the vulnerable factor for renal diseases. It's oxidative stress reduction function helps to maintain the health of cells and heart (Chen, 2018).

2.2.5 Didymin:

Didymin, oral bioactive citrus flavonoid found in many citrus plant products such as grapes, oranges, lemons, mandarins (Yao, 2018). This is consisting of the ability in the molecular

mechanisms related to insulin resistance activity of the cells which is the main factor of diabetes mellitus (Ali, 2019). This flavones helps in prevent hyperglycemia induced symptoms like polyphagia, polyuria etc. By besides, didymin showed important vascular effects that is favourable for glycemic control.

2.2.6 Xanthohumol:

Xanthohumol, a bioactive phytocompound found in citrus plants in the species Rutaceae, it is an antioxidant molecule which is linked to a grand range of bioactivities, including anticancerous, anti-inflammatory, and antioxidant properties (Jiang, 2018 & Li, 2018). An test included in a survey picturized that xanthohumol suppresses the range of Gal3, a protein which is directly connected to various complications and diabetic progression. By besides, it reduced Gal3 expression, and stress of oxidation and the biomarkers which are associated with diabetes mellitus such as 3-nitrotyrosine and (Acute Gastroenteritis) AGEs in the liver and kidneys (Moher, 2009).

2.2.7 Quercetin:

This citrus flavonoid, is present in different citrus plants. It also has many therapeutic functions that reduce the risk of inflammation, infection, tumor formation possibilities. Oranges, lemons, sour oranges, watermelon and grapes are common sources of quercetin (Wang, 2017). Therefore, this flavone group compound considered as one of the most popular citrus flavonoids in the wide citrus fruit market, and it is commonly used as a component in nutraceuticals and food supplements. A number of food products containing this flavonoid have been patented as it has absolutely outstanding therapeutic ability as a disease-fighting antioxidant compound that can improve health status and reduce diabetic effects (Sharma, 2018).

2.2.8.Magnoliol:

In this review, Szaabska-Rapa et al (Szałabska-Rąpała, 2021). discussed the anti-diabetic effects of magnoliol, a lignan from Magnolia bark. The plant-derived compound magnoliol shows potential as a treatment and prevention for type 2 diabetes. In addition to conventional therapy, magnolol may enhance diabetic negative effects on the body by complementing conventional therapies.

3. Conclusion:

In conclusion, phytochemicals are potential agent to treat diabetes and diabetic complications. Flavonoids like querecitin, naringin, naringenin etc. which are the main potential component in citrus fruits has many beneficial effects on diabetes as it has the ability to regulate biomarkers of glycaemic control, lipid profiles, renal function, hepatic enzymes, and antioxidant enzymes, and modulated signaling pathways co- related to glucose uptake and insulin sensitivity. Extract of Moringa oleifera Lam. could be used to treat diabetes complications. Natural epidrugs have shown to prevent or delay T_2DM development and the complications associated with the dysfunction of blood vessels, eyes and kidneys due to hyperglycaemia in T2DM patients. Nymphaea species have had a load of phytochemical constituents which shows anti-inflammatory, anti-oxidant and antiglycation value by inhibiting AGEs in mediation of T2DM. Parkia speciosa Hassk. and its hypoglycaemic properties like beta-sitosterol, stigmasterol, and stigmat-4-en-3-one are known to play pivotal roles in the initiation and severity of diabetic cardiovascular diseases, thus targeting these factors might be beneficial for preventing and/or treating diabetic vasculopathy. The anti-diabetic effects of Momordica charantia can be attributed to its different bioactive substances such as vicine, charantin, glycosides, karavilosides, polypeptide-p, and plant insulin. All these informations recommended that phytochemicals have crucial roles in T_2DM.

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