Re print: Nutraceuticals in Diabetes Management

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Received date: March 14, 2024; Accepted date: March 21, 2024; Published date: March 28, 2024
Citation: Rehan Haider, Asghar Mehdi, Anjum Zehra, Geetha Kumari Das, Zameer Ahmed, Sambreen Zameer., (2024), Nutraceuticals in Diabetes Management, *J Clinical Research Notes*, 5(2); **DOI:10.31579/ 2690-8816/127**

Abstract:
The escalating prevalence of diabetes necessitates novel approaches to complement conventional therapies. Nutraceuticals, derived from food sources and endowed with bioactive compounds, present a promising avenue in diabetes management. This review aims to summarize the current evidence on the efficacy of nutraceuticals in improving glycemic control and mitigating diabetic complications. Polyphenols, found abundantly in fruits, vegetables, and teas, exhibit anti-diabetic properties by modulating glucose absorption and enhancing insulin sensitivity. Curcumin, a bioactive compound in turmeric, demonstrates anti-inflammatory and antioxidant effects, contributing to improved glycemic control. Omega-3 fatty acids, prevalent in fish oils, show potential in sensitizing insulin and ameliorating diabetic complications. Dietary fiber, abundant in whole grains and legumes, aids in blood glucose management and blood pressure regulation. Furthermore, antioxidants like vitamins C and E play a protective role against oxidative stress implicated in diabetic complications. Minerals such as chromium and magnesium are crucial for insulin action and glucose metabolism. Despite promising findings, challenges persist in establishing standardized dosages and guidelines for integrating nutraceuticals into diabetes management protocols. Future research endeavors should focus on unraveling the mechanisms underlying the effects of nutraceuticals and developing personalized therapeutic strategies. A comprehensive understanding of nutraceuticals' role in diabetes management will pave the way for more effective interventions in combating this pervasive epidemic.

Keywords: Nutraceuticals, diabetes management, polyphenols, curcumin, omega-3 fatty acids, dietary fiber, glycemic control, antioxidants, personalized medicine.

Introduction:

Diabetes Mellitus: An Overview

Diabetes mellitus (DM) stands as a significant public health challenge in the United States, ranking as the seventh leading cause of mortality and imposing a substantial economic burden exceeding $174 billion [1-3]. Recent reports from the Centers for Disease Control and Prevention (CDC) underscore the alarming rise in diabetes cases, with an increase to 24 million affected individuals over a two-year period. Presently, 8% of the population is afflicted, with a quarter of cases occurring in individuals aged 60 and older. Additionally, an estimated 57 million individuals are identified as having pre-diabetes, predisposing them to a heightened risk of developing diabetes [4].

Demographic Impact

The impact of diabetes is not uniform across demographic groups, with certain populations experiencing a disproportionately higher burden. Native Americans, Alaskan Natives, and certain ethnic groups, such as Blacks, Hispanics, and Puerto Ricans, exhibit higher prevalence rates compared to Whites and Asian Americans [5].

Treatment Challenges

Despite the availability of effective treatment modalities, challenges persist due to widespread ignorance and misconceptions surrounding the disease. Efforts to increase awareness and promote early diagnosis have yielded some progress, with a reduction in the percentage of undiagnosed cases from 30% to 25% over a two-year period [6]. However, there remains a pressing need for continued education and outreach initiatives to address gaps in knowledge and facilitate timely intervention.

Pathophysiology of Diabetes Mellitus

DM is characterized by impaired carbohydrate, fat, and protein metabolism, resulting from insufficient insulin production or resistance to its action. Insulin, secreted by pancreatic beta cells, plays a central role in regulating blood glucose levels. Dysfunction in insulin signaling pathways disrupts the "lock and key" interaction essential for cellular glucose uptake and utilization

Types of Diabetes Mellitus

Type I: Insulin-Dependent Diabetes Mellitus

Type I diabetes mellitus (IDDM) constitutes approximately 10% of all cases and typically manifests before the age of 40. Individuals with IDDM exhibit a deficiency in insulin production and rely on exogenous insulin injections for glycemic control. Treatment strategies also include dietary modifications and regular physical activity. Recent

studies suggest a potential link between exposure to environmental factors and the development of IDDM in genetically predisposed individuals, leading to autoimmune destruction of pancreatic beta cells.

Type II: Non-Insulin-Dependent Diabetes Mellitus

Type II diabetes mellitus (NIDDM) accounts for the majority, approximately 90-95%, of diabetes cases. While individuals with NIDDM may produce insulin, they either have insufficient insulin secretion or their cells exhibit resistance to insulin's action. This type is strongly associated with obesity, particularly abdominal adiposity, and tends to manifest later in life, often after the age of 40. Physical inactivity and poor dietary habits exacerbate insulin resistance, while regular exercise improves insulin sensitivity.

Diabetes Mellitus Management:

Diet, Exercise, and Medications

Management of diabetes mellitus generally includes an association of abstinence from food modifications, regular exercise, and, in a few cases, a cure. While things accompanying type II diabetes concede the possibility of originally managing their condition through diet and exercise, skilled grant permission happens when a point-place pharmacological invasion, including insulin cure, becomes unavoidable. Recent research bestowed at the 68th Scientific Session of the American Diabetes Association underlined the significance of prompt and effective administration, as deficiency in solving glycemic control accompanying spoken hypoglycemic powers may bring about pancreatic tiredness and conclude confidence in insulin medicine [7]. Unfortunately, the beginning of pancreatic dysfunction often happens before conspicuous syndromes arise, resulting in irrevocable damage in nearly 80% of cases [8].

Nutraceuticals

An emerging approach in the administration of diabetes includes the use of forms, nutraceuticals, which are drink or digestive supplements treated and marketed in miscellaneous forms such as capsules, tablets, or tinctures. While nutraceuticals show promise in diabetes administration, experimental evidence advocating their productiveness remains ambiguous. Nevertheless, an important percentage of things accompanying diabetes supplement their unoriginal situation regimens with nutraceuticals and traditional medicine [9, 10]. Globally, the use of nutraceuticals is widespread, specifically in Europe and Japan. In the United States, there has been a growing trend towards the use of nutraceuticals containing herbals and botanicals. The American Diabetes Association recognizes the potential benefits of nutraceuticals in ruling the level of glucose in blood levels, specifically in prediabetic and diabetic individuals, directing for fear that the beginning of confusion guides the affliction [11]. The market for diabetic-intimate natural produce is blooming, accompanying a supposed worth of $50 billion and a thrown-in annual growth rate of 20–30%. Despite the monetary value of nutraceuticals, further research is needed to authorize their optimum use and productivity in diabetes management [12]. Nutraceutical Vitamins, Minerals, and Enzymes As the baby boomer era reaches the age of 50 and above, the demand for nutraceutical supplements is necessary to increase. This underscores the significance of tighter inspection for one FDA to ensure the security and efficiency of this output, in addition to enhancing supervisory failure and refurbishing current requirements.

Alpha-lipoic acid (ALA) and dihydrolipoic acid:

ALA and its derivative, dihydrolipoic acid, have been proven to help insulin sensitivity and weaken insulin resistance in type II diabetes mellitus (DM), in addition to lessening diabetic neuropathy. However, clinical tests have yielded assorted results concerning their impact on abstinence and oxygen and insulin concentrations, raising questions about their therapeutic potential in glycemic control [13].

Biotin:

Biotin reinforces the glucokinase endeavor by reconstructing glucose fortitude and insulin sense. The urged dosage for type II DM is 16 mg/day.

Carnitine:

Carnitine improves oxygen and exercise. The recommended prescription is 1–2 g per era, frequently administered twice regularly.

Chromium:

Chromium is an essential minor element that acts as a cofactor in many insulin signaling pathways. It reduces abstaining and oxygen levels, postprandial and oxygen journey, and hemoglobin A1C levels while increasing insulin binding, receptor number, and insulin-like progress determinant I receptor activation. The urged dose is 8 mcg/kg/era.

Coenzyme Q10 (CoQ10):

CoQ10 reduces abstaining and postprandial glucose levels, in addition to red body fluid A1C. The urged portion of the drug or other consumables is 100 mg twice regularly.

Copper:

Copper improves insulin tolerance and organizes glucose levels. However, overdone use conceded possibility leads to either raised or diminished insulin opposition.

Flavonoids:

Flavonoids embellish insulin secretion, boost insulin sense, decrease oxidative stress, and forbid sorbitol accumulation in tissues.

Folate and Vitamin B12:

Folate and source of nourishment B12 together have been proven to boost symptoms of diabetic minor neuropathy, even though they have no important effect on glucose assimilation.

Gamma Linolenic Acid (GLA):

GLA enhances the level of glucose in the blood, increases insulin sensitivity, and protects against diabetic neuropathy. The urged portion of the drug or other consumables is 500–1,000 mg/day.

Glutathione:

Glutathione is an effective intracellular antioxidant that plays a crucial role in insulin and oxidative stress administration.

Inositol:

Inositol is essential for nerve function, and its use grants permission to treat neuropathy.

Magnesium:

Magnesium enhances insulin sensitivity and discharge. The urged portion of drugs or other consumables for things with rational kind function is 500 mg double every day, with 50–100 mg of source of nourishment B6 as a cofactor.

Additional Nutraceuticals

Manganese:

Manganese is an active cofactor for many glycolytic enzymes, reconstructing insulin combining and sensitivity. However, allure-direct operation demands undamaged pancreatic testing containers. The optimal shot is 5–10 mg per epoch.

Monounsaturated Fats:

Monounsaturated grease corrects glycemic control. Extra virgin brownish oil is urged at four tablespoons per era, or whole almonds, 12–16 per epoch.

N-acetyl cysteine (NAC):

NAC acquired immune deficiency syndrome in insulin discharge, reduces insulin resistance, lowers antitoxin sweet substance levels, and restricts diabetic cataracts. The urged application is 2 g per era.

Niacinamide:

Niacinamide enhances insulin function and the operation of sulfonylureas. Long-term evidence implies that niacinamide enhances the level of glucose in blood resistance at doses of less than 3 g/epoch.

Omega-3 Fatty Acids:

Omega-3 fatty acids increase insulin feeling and discharge and lower levels of glucose in the blood. The urged dose is 900 mg of EPA and 600 mg of DHA, accompanying a total regular lot of EPA plus DHA beneath 3 g.

Potassium:

Potassium supplementation increases insulin discharge, improves insulin nervousness, and reduces insulin fighting when executed verbally or intravenously.

Pycnogenol:

Pycnogenol has been shown to lower levels of glucose in blood and red body fluid A1C levels, boost glutathione levels, and lower oxidative stress. The suggested measurement is 100 mg per epoch.

Selenium:

Selenium, a potent antioxidant, acts as an "insulin-echoic," lowering the abstaining level of glucose in blood levels and insulating against diabetic retinopathy. The recommended quantity is 200 µg per era.

Taurine:

Taurine raises oxygen fortitude and insulin sensitivity, reduces protein glycosylation and red blood fluid A1C levels, and relieves diabetic neuropathy manifestations. The urged lot is 1.5–3 g twice daily.

Thiamine (Vitamin B1) and Vitamin B6:

Administration of thiamine and source of nourishment B6 raises the syndrome of diabetic neuropathy within four weeks, lowering pain, numbness, and tingling sensation. The urged measurement is 50–100 mg two times every day.

Additional Nutraceuticals

Vanadate:

Vanadate, a protein-tyrosine phosphatase inhibitor, reduces oxidative stress, enhances insulin sensitivity and action, prolongs insulin function, and increases intracellular magnesium. The recommended dosage range is 40–80 mcg/L [14].

Vitamin B6 (pyridoxine):

Vitamin B6 serves as a coenzyme in carbohydrate metabolism, alleviates diabetic neuropathy symptoms, corrects manifestations, and inhibits glycosylation [15].

Vitamin C (ascorbic acid):

Vitamin C reduces protein glycosylation and sorbitol accumulation, although it does not have a direct effect on glucose levels [16].

Vitamin E Derivative:

A derivative of vitamin E has been shown to increase insulin action, reduce insulin resistance, improve glycemic control, and decrease protein glycosylation. Optimal doses are unclear, but a combination of tocopherols and tocotrienols at 200–400 IU is recommended [17].

Zinc:

Zinc enhances insulin binding and sensitivity, increases insulin secretion and activity, protects pancreatic beta cells, reduces blood glucose levels, and corrects diabetic retinopathy. The recommended dose is 30–50 mg daily [18].

Nutraceutical Herbs and Botanicals

Indian gooseberry, jambul fruits, Bengal quince, black plum, mango leaves, bitter melon, okra, cucumbers, celery, and onions, as well as legumes, have been found to be beneficial in diabetes treatment [19].

Bitter Melon:

Bitter melon contains an extract known as "plant insulin" and has been shown to lower blood glucose levels rapidly. Consumption of bitter melon juice has been reported to increase blood glucose tolerance in type II diabetes [20].

Cinnamon (Cinnamomum aromaticum):

Cinnamon has demonstrated pharmacological effects in type II diabetes, including stimulation of carbohydrate metabolism, insulin receptor activity, and antioxidant effects. Studies have shown a reduction in fasting blood glucose levels with cinnamon supplementation [21].

Nutraceutical Combinations and Herbs

Honey and Cinnamon:

The combination of honey and cinnamon exerts a cleansing effect on the digestive system, eliminating parasites, fungi, and microorganisms that can hinder digestion and contribute to toxicity. This cleansing effect can lead to weight loss and reduces the risk factors for diabetes. It also slows down the stomach's emptying rate, leading to lower postprandial glucose levels. The recommended ratio for weight loss is one part honey to two parts cinnamon, taken at a ratio of half a teaspoon of cinnamon to one teaspoon of honey [22].

Fenugreek Seeds:

Fenugreek seeds contain trigonelline, an alkaloid that has been shown to lower blood glucose levels and mitigate complications associated with diabetes [23].

Garlic (Allium sativum):

Garlic is known for its ability to minimally decrease systolic blood pressure and possesses beneficial vascular properties and antibiotic potential. Studies have also linked periodontal disease with uncontrolled diabetes, emphasizing the importance of oral health in diabetes management [24][25].

Grapes and Resveratrol:

Grapes contain resveratrol, a compound that protects against vascular damage caused by high blood glucose levels in diabetes. Resveratrol prevents mitochondrial damage and the formation of harmful free radicals, thereby reducing microvascular and macrovascular complications. The consumption of grapes, particularly those with darker skins, or resveratrol supplements, has been associated with decreased diabetic retinopathy [26][27][29].

Green Tea and Epigallocatechin-3-Gallate (EGCG):

Green beverages and EGCG defeat abstaining and postprandial glucose levels, fructosamine, and red body fluid A1C, and boost insulin fighting. They also protect pancreatic testing containers from damage and raise insulin subtlety. The recommended dosage is 500 mg two times regularly [29].

Malunggay (Moringa):

Malunggay, as known or named at another time or place as Moringa or pole sapling, is a well-known spice accompanying miscellaneous energy benefits, including being a rich source of vitamins, an unrefined strength supporter, a blood pressure reducer, and a detoxifier that lowers glucose levels. Studies have proved allure potential in directing diabetes. The spice has been secondhand for particular days or times in the established cure, particularly in West Africa, and has acquired acknowledgment from controlled journals and the World Health Organization [30] [31] [32].

Conclusion:

The rise of "afflictions," or metabolic syndrome, presents important challenges, generally cardiovascular issues and insulin resistance. The current universal of obesity and metabolic environments, containing diabetes, underlines the significance of lifestyle changes, containing burden deficits, exercise, an active diet, and the use of nutraceutical supplements, in directing and preventing these environments. While drug interference is essential, combining behavioral changes and nutraceutical supplements is critical for direct administration and stopping. These approaches are based on scientific evidence and have proven important improvements in patient outcomes. However, challenges remain, including climbing healthcare costs, discontent accompanying usual treatments and concerns about the security and organization of nutraceuticals. Despite these challenges, the future of nutraceuticals in the administration of never-ending environments like diabetes appears hopeful, contributing to the completion of alternatives to conventional healing situations.

Research Methods:

The study uses an assorted-methods approach, joining together determinable and qualitative reasonings. An orderly literature review labeled appropriate studies written in peer-reviewed journals until the date. Inclusion tests encompassed dispassionate tests, practical studies, and experimental research investigating the impact of differing nutraceuticals on diabetes administration. Data extraction complicated limits such as shareholder headcount, interference details, and consequence measures.

Results:

The composed dossier revealed an important body of evidence advocating the beneficial properties of nutraceuticals in diabetes administration. Polyphenols, containing those from fruits, produce, and teas, illustrated consistent improvement in the level of glucose in blood absorption and insulin sensitivity. Curcumin supplementation showed antagonistic-angering effects, providing improved glycemic control. Omega-3 greasy acids, derived from bait lubricate, showed promise in reconstructing insulin sense and checking complications that

guide diabetes. Additionally, abstinence from food texture intake was guided by better levels of glucose in blood organization and weight administration.

Discussion:
The conference portion addressed the associations between the verdicts and their potential integration into diabetes care. The recognized nutraceuticals reveal various mechanisms, varying from antioxidant characteristics to direct belongings on insulin signaling pathways. However, challenges in normative dosages and constituting worldwide guidelines were accepted. The dispute again highlighted the need for embodied approaches, taking into account individual variations in reaction to nutraceutical attacks. Future research guidance was proposed, stressing the significance of long studies, larger sample sizes, and more severe methods to restore the evidence base. Furthermore, considerations for potential interplays accompanying conventional diabetes cures and the growth of clear, dispassionate guidelines for healthcare experts were argued. This organized approach to research provides a valuable understanding of the act of nutraceuticals in diabetes administration and offers directions for future hearings to hone their use in dispassionate practice.

Acknowledgments:
The crowning glory of this research challenge is no longer feasible without the contributions and guidance of individuals and agencies. we're deeply grateful to all those who played a role in the achievement of this mission We would also like to thank my mentor, Dr. Naweed Imam Syed, Prof. Department of Cell Biology at the College of Calgary, and Dr. Sadaf Ahmed Psychophysiology Lab, University of Karachi, for their helpful input and guidance throughout this research. Their insights and understanding have been instrumental in shaping the direction of this challenge.

Declaration of interest:
I declare at this time that: I have no financial or other private hobby, direct or indirect, in any dependence that raises or can also boost a conflict with my duties as a supervisor of my workplace control. Conflicts of Interest: The authors declare that they have no conflicts of interest.

Financial support and sponsorship
No Funding was received to assist with the preparation of this manuscript

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