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Turmeric Performance Measures in Diabetes: The Current Status

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ABSTRACT

Turmeric (*Curcuma longa*), a rhizomatous herbaceous perennial plant of the ginger family, has been used for the treatment of diabetes in Ayurvedic and traditional Chinese medicine. The active component of turmeric, curcumin, has caught attention as a potential treatment for diabetes and its complications primarily because it is a relatively safe and inexpensive drug that reduces glycemia and hyperlipidemia in rodent models of diabetes. Here, we review the recent literature on the applications of curcumin for glycemia and diabetes-related liver disorders, adipocyte dysfunction, neuropathy, nephropathy, vascular diseases, pancreatic disorders, and other complications, and we also discuss its antioxidant and anti-inflammatory properties. The applications of additional curcuminoid compounds for diabetes prevention and treatment are also included in this paper. Finally, we mention the approaches that are currently being sought to generate "super curcumin" through the improvement of the bioavailability to bring this promising natural product to the forefront of diabetes therapeutics.

INTRODUCTION

Natural products have received considerable attention for the management of diabetes and its complications which have reached epidemic levels worldwide. The spice turmeric, which is derived from the root of the plant *Curcuma longa*, has been described as a treatment for diabetes in ayurvedic and traditional Chinese medicine for thousands of years. The most active component of turmeric, curcumin, has caught scientific attention as a potential therapeutic agent in experimental diabetes and for the treatment of the complications of diabetes patients.

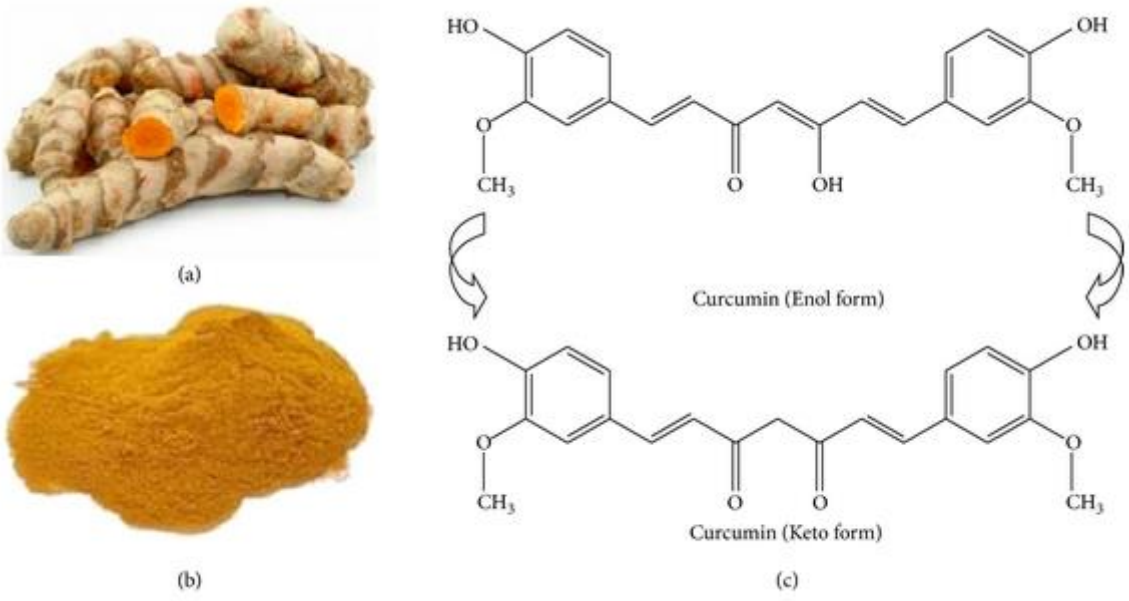

Figure no: 1 Turmeric, curcumin and it's the chemical structure

Turmeric and diabetes

Share on Pinterest Turmeric and its compounds may help with conditions such as diabetes and psoriasis.

Scientists believe that turmeric may have properties that help reduce inflammation and oxidative stress, which are factors that appear to play a role in diabetes. For this reason, they believe that turmeric may be useful for people with diabetes.

Turmeric contains a compound called curcumin, which appears to be the source of many of its health benefits. Most research to date has focused on curcumin rather than the whole turmeric.

The results suggest that curcumin can help people with diabetes in different ways, which may include improving insulin resistance and cholesterol levels.

Curcumin and Other diabetes-associated Complications

The effects of curcumin on other diabetes-associated complications have been demonstrated by several studies. First, several groups demonstrated that **curcumin** was effective against the diabetes-induced musculoskeletal disease.

Effect of curcumin on pancreatic cell dysfunction

The effect of curcumin on pancreatic cells has been extensively studied. First, curcumin increased islet viability and delayed islet ROS production, which is mediated through inhibiting poly ADP-ribose polymerase-1 activation (STZinduced islet damage) and normalizing cytokine (TNFα, IL-1β, and interferon-γ)-induced NF-κB translocation by inhibiting phosphorylation of inhibitor of kappa B α(IκBα) without affecting normal islet function in vitro, and by normalizing glucose clearance and pancreatic GLUT2 leves5.

Type 1 diabetes immune response

Scientists believe that type 1 diabetes occurs when the immune system attacks insulin-producing beta cells in the pancreas.

A 2014 article Trusted Source noted that curcumin might adjust how the overactive immune system works in people with type 1 diabetes.

The researchers found that curcumin lowers the body's T-cell response, which is part of its immune response. This finding suggests that curcumin may help strengthen the immune system.

It could also boost the action of immunomodulatory medicines that doctors prescribe to manage type 1 diabetes.

How to use turmeric for diabetes

People with diabetes should use insulin or other medications as their doctor advises and take the following lifestyle measures to reduce the risk of complications: eating a healthful diet that includes plenty of nonstarchy vegetables and fiber exercising regularly managing stress levels quitting smoking if necessary and avoiding secondhand smoke where possible getting regular sleep.

Curcumin Extract for Prevention of Type 2 Diabetes

According to the World Health Organization, there are;311 million people worldwide who live with T2DM. This number continues to rise, especially in the newly developing and poorer countries in Asia and elsewhere. Because T2DM is currently incurable, a common treatment approach is to try to control the disease with lifelong use of antidiabetes drugs. Limiting the number of newly developed T2DM cases should be one of the better key strategies to restrict the global impacts of T2DM (2). To limit the number of new T2DM cases, the lifestyle of the prediabetic population has to be changed. However, this is challenging.

Preparation of curcuminoids capsules

Dried rhizomes of turmeric (Curcuma longa Linn.) grown in Kanchanaburi province, Thailand, were ground into powder. The turmeric powder was extracted with ethanol and evaporated at low pressure to obtain ethanol extract in the form of semisolid containing oleoresin and curcuminoids. The oleoresin was removed to yield curcuminoid extract (total curcuminoid content between 75 and 85%). The peak ratio of curcumin:demethoxycurcumin and bisdemethoxycurcumin in the extract were determined by high-performance thin-layer chromatography. The extract (calculated for 250 mg of curcuminoids) was filled into capsules under the Good Manufacturing Procedures standard. Fingerprints of the extract and a detailed analysis of the chemical composition of the preparation in the extract are shown in Supplementary.

Curcumin and Diabetic Neuropathy

Diabetic neuropathy is a neuropathic disorder that is associated with DM. These conditions are thought to result from diabetic microvascular injury, elevated AGEs, and activated protein

kinase C (PKC). Curcumin has been actively involved in modulating diabetic neuropathic disorders by the following lines of evidence. Curcumin effectively suppressed the development of diabetic cataracts in rat models of STZ-induced diabetes by reversing changes in lipid peroxidation, reduced glutathione, protein carbonyl content, and activities of antioxidant enzymes, which is beneficial to normalize expression of αA-crystallin and αB-crystallin. Increased expression of αA-crystallin and decreased expression of αB-crystallin were contributed to the reduction hydrophobicity and altered secondary and tertiary structures of acrystallin 10.

Curcumin and Its Anti-Inflammatory Actions

Inflammation is now recognized as one of the main contributors to diabetes and maybe elaborated by diminishing the underlying causes S. The beneficial effect of curcumin on diabetes may be due to its ability to spice up the immune system. Margina et al. showed that curcumin restored transmembrane potential and stiffened membrane fluidity, limiting the release of pro-inflammatory factors, such as MCP- 1 from endothelial and immune cells in human umbilical vein endothelial cells and Jurkat T lymphoblasts in the presence of high glucose or increased concentrations of AGEs. These effects were more obvious during the late stages of diabetes.

Curcumin and Diabetic Nephropathy

Diabetic nephropathy is a clinical syndrome characterized by persistent albuminuria, progressive decline in the glomerular filtration rate, and elevated arterial blood pressure. Currently, diabetic nephropathy is the leading cause of chronic kidney disease and one of the most significant long-term complications in terms of morbidity and mortality for individual patients with diabetes. There are multiple mechanisms by which curcumin may ameliorate renal damage. Curcumin increases blood urea nitrogen [21, 95] and promotes clearance of creatine and urea 12.

Curcumin and Adipose Tissue Dysfunction

Adipose tissue plays an important role in controlling whole-body glucose homeostasis Development of type 2 diabetes may involve the deregulation of adiponectin secretion. Recent studies revealed that curcumin stimulated human adipocyte differentiation and suppressed macrophage accumulation or activation in adipose tissue by regulating

adiponectin secretion. The mechanism may be due to suppression of NF-κB activation [63], which reduces TNF-$\alpha$and nitric oxide (NO) and inhibits the release of monocyte chemotactic protein-1 (MCP-1) from 3T3-L1adipocytes. Further studies also showed that suppression of 3T3-L1 adipocytes by curcumin was mediated through activation of Wnt/β-catenin signaling, which resulted in increased mRNA levels of c-Myc and cyclin D1. As is known to us, c-Myc and cyclin D1, well-known downstream target genes of β-catenin, were shown to prevent adipogenesis.

Curcumin and Its Anti-Inflammatory Actions

Inflammation is now recognized as one of the main contributors to diabetes and may be ameliorated by diminishing the underlying causes. The beneficial effect of curcumin on diabetes may be due to its ability to spice up the immune system. Margina et al. showed that curcumin restored transmembrane potential and stiffened membrane fluidity, limiting the release of pro-inflammatory factors, such as MCP-1 from endothelial and immune cells in human umbilical vein endothelial cells and Jurkat T lymphoblasts in the presence of high glucose or increased concentrations of AGEs. These effects were more obvious during the late stages of diabetes. Sharma et al. showed that curcumin suppressed the activities of T- and B-lymphocytes and macrophages by inhibiting proliferation, antibody production (IgG1 andIgG2a), and lymphokine secretion (IL-4, IL-1, IL-6, and TNF-α) mainly by downregulating CD28 and CD80 and upregulating CTLA-4. In U937 monocytes, curcumin inhibited IL-6, IL-8, MCP-1, and TNF-αsecretion in response to high glucose (35 mm). These effects were also reflected in STZ-induced diabetic rats, which exhibited significantly reduced blood levels of IL-6, MCP-1, TNF-α, glucose, HbA(1), and oxidative stress. Also, curcumin suppressed the release of proinflammatory cytokines and histone acetylation in human monocytic (THP-1) cells, as demonstrated by increased activity of histone deacetylases (HDACs), reduced histone acetyltransferase (HAT) activity, reduced expression of p300 and acetylated CBP/p300.

Interactions between curcumin and Antidiabetic drugs.

The increased use of combined natural products and conventional drugs rises the need of knowing their possible pharmacological interaction .this field has been little explored for curcumin and the few existing studies about its pharmacological interactions with conventional antidiabetic drugs are mainly with Sulfonylureas.

SUMMARY

Recent research has provided the scientific basis for "traditional" curcumin and confirmed the important role of curcumin in the prevention and treatment of diabetes and its associated disorders. Curcumin could favorably affect most of the leading aspects of diabetes, including insulin resistance, hyperglycemia, hyperlipidemia. Also, curcumin could prevent deleterious complications of diabetes. Despite the potential tremendous benefits of this multifaceted nature product, results from clinical trials of curcumin are only available in using curcumin to treat diabetic nephropathy, microangiopathy, and retinopathy so far. Studies are badly needed to be done in humans to confirm the potential of curcumin in limitation of diabetes and other associated disorders. Further, multiple approaches are also needed to overcome limited solubility and poor bioavailability of curcumin. These include synthesis of curcuminoids and development of novel formulations of curcumin, such as nanoparticles, liposomal encapsulation, emulsions, and sustained released tablets. Enhanced bioavailability and convincing clinical trial results of curcumin are likely to bring this promising natural product to the forefront of therapeutic agents for diabetes by generating a "super curcumin" shortly.

Conflict of Interest

The authors declare that they have no conflicting interests.

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