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Role of curcuma longa in treating various metabolic disorders

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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 a "super curcumin" through improvement of the bioavailability to bring this promising natural product to the forefront of diabetes therapeutics.

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I. INTRODUCATION

Natural products have received considerable attention for the management of diabetes and its complications [1–3] which have reached epidemic levels worldwide [4]. The spice turmeric, which is derived from the root of the plantCurcuma longa, has been described as a treatment for diabetes in Ayurvedic [5] and traditional Chinese medicine for thou_sands 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 complica_tions of diabetes patients [7], primarily because it is effective in reducing glycemia and hyperlipidemia in rodent models and is relatively inexpensive and safe [8–10]. The structure of curcumin. shown to be a diferuloylmethane, was resolved by Lampe and Milobedeska in 1910 [11]. We retrieved more than 200 publications with the search term "curcumin and diabetes" from the MEDLINE database in 2013. The first paper that described an effect of curcumin related to diabetes described a blood glucose lowering effect of the drug in one diabetic individual only and was published in 1972 [12]. Curcumin has been since extensively studied in experimentalanimal models of diabetes and in a few clinical trials of type 2 diabetic patients to treat their complications [13]. This review seeks to briefly summarize the ample scientific literatures regarding curcumin as a potential treatment for diabetes and its associated complications. Particular attention will be given to the anti-inflammatory and antioxidant properties of cur_cumin.

METABOLIC SYNDROME

Metabolic syndrome is a group of five risk factors that can lead to heart disease, diabetes, stroke and other health problems. Metabolic syndrome is diagnosed when someone has three or more of these conditions:

• High blood glucose (sugar)
• Low levels of HDL ("good") cholesterol in the blood
• High levels of triglycerides in the blood
• Large waist circumference or "apple-shaped" body
• High blood pressure

Although each of these is a risk factor for cardiovasculardisease, when a person has three or more and is diagnosed with metabolic syndrome, it increases the chance of developing a serious cardiovascular condition.

Who's at risk for metabolic syndrome

In recent years this syndrome has become much more common in the United States. Over 34% of U.S. adults have it. It's also increasing globally. Although some people are genetically prone to developing metabolic syndrome, others get it as result of their IS are:

• Obesity/overweight. Excessive fat in and around theabdomen (stomach) is most strongly associated with metabolic syndrome.
• Insulin resistance. This is when the body can't use insulin efficiently. Some people are genetically predisposed to insulin resistance.

• Race and gender. Although Black men are less likely than white men to have metabolic syndrome, Black women have a higher rate than white women.
• Age. Risk of developing metabolic syndrome increases with age.

How is it diagnosed?
Most of the conditions that make up metabolic syndrome have no signs or symptoms. But a large waistline is a visible sign of being overweight or obese.
You are diagnosed with metabolic syndrome if you have three or more of these conditions:
• Central or abdominal obesity. This is measured by waist circumference:
– Men: greater than 40 inches
– Women: greater than 35 inches
• High triglycerides: 150 mg/dL or more, or you're taking medicine for high triglycerides
• Low HDL cholesterol, or you're taking medicine for low HDL cholesterol:
– Men: Less than 40 mg/dL
– Women: Less than 50 mg/dL
• High blood pressure: 130/85 mmHg or more, or you're taking medicine for high blood pressure
• High fasting glucose (blood sugar): 100 mg/dL or more, or you're taking medicine for high blood glucose.

MEDICINAL USE OF CURCUMA LONGA
The earliest known reference to turmeric's medicinal use can be found in the ancient text Atharvaveda, where turmeric is prescribed as a treatment for leprosy and jaundice. In fact, a popular custom in ancient India involved a spiritual healer spreading turmeric paste over the disease-afflicted body of the patient before performing a magical, spell-like ritual and washing the body to rid it of the illness.
Ground turmeric was also sprinkled over the skin in leech therapy to help detach the leech and promote faster wound healing. Meanwhile, Unani (Persian traditional medicine) practices include the use of turmeric for the expulsion of phlegm, as well as for the improvement of blood circulation.
In many parts of Asia, the turmeric rhizome or root is considered the most valuable healing and preventative herbal medicine out there. Besides the above-mentioned turmeric treatments, this herb has also been used for millennia for a variety of illnesses related to digestion, infertility, urinary disorders, fever, dental problems, ulcers, worms, gas relief, and menstrual pain.

CURCUMA LONGA IN DIABETES
Diabetes mellitus (DM) is an ensemble of metabolic conditions that have reached pandemic proportions worldwide. Pathology's multifactorial nature makes patient management, including lifelong drug therapy and lifestyle modification, extremely challenging. Currently, there is growing evidence about the effectiveness of using herbal supplements in preventing and controlling DM. Curcumin is a bioactive component found Curcuma longa, which exhibits several physiological and pharmacological properties such as antioxidant, anti-inflammatory, anticancer, neuroprotective, and anti-diabetic activities. For these reasons, our objective is to systematically review the effects of Curcuma longa or curcumin on DM. Databases such as PUBMED and EMBASE were searched, and the final selection included sixteen studies that fulfilled the inclusion criteria. The results showed that curcumin's anti-diabetic activity might be due to its capacity to suppress oxidative stress and inflammatory process. Also, it significantly reduces fasting blood glucose, glycated hemoglobin, and body mass index. Nanocurcumin is also associated with a significant reduction in triglycerides, VLDL-c, total cholesterol, LDL-c, HDL-c, serum C reactive protein, and plasma malonaldehyde. Therefore, it can be considered in the therapeutic approach of patients with DM.

CURCUMA LONGA IN CARDIOVASCULAR DISEASES
Cardiovascular diseases (CVDs) are one of the leading causes of the most considerable mortality globally, and it has been tried to find the molecular mechanisms and design new drugs that triggered the molecular target. Curcumin is the main ingredient of Curcuma longa (turmeric) that has been used in traditional medicine for treating several diseases for years. Numerous investigations have indicated the beneficial effect of Curcumin in modulating multiple signaling pathways involved in oxidative stress, inflammation, apoptosis, and proliferation. The cardiovascular protective effects of Curcumin against CVDs have been indicated in several studies.
In the current review study, we provided novel information on Curcumin's protective effects against various CVDs and potential molecular signaling targets of Curcumin. Nonetheless, more studies should be performed to discover the exact molecular target of Curcumin against CVDs.

CURCUMA LONGA IN CANCER

Curcumin is a polyphenol extracted from the rhizomes of the turmeric plant, Curcuma longa which has anti-inflammatory, and anticancer properties. Chronic inflammation is associated with the development of cancer. Curcumin acts on the regulation of various immune modulators, including cytokines, cyclooxygenase-2 (COX-2), and reactive oxygen species (ROS), which partly explains its anticancer effects. It also takes part in the downregulation of growth factors, protein kinases, oncogenic molecules and various signaling pathways, such as nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB), c-Jun N-terminal kinase (JNK) and signal transducer and activator of transcription 3 (STAT3) signaling. Clinical trials of curcumin have been completed or are ongoing for various types of cancer. This review presents the molecular mechanisms of curcumin in different types of cancer and the evidence from the most recent clinical trials.

CURCUMA LONGA IN HYPERTENSION

Untreated hypertension is a major cause for a wide array of diseases affecting cardiovascular system. Oxidative stress has been implicated in the development of hypertension. The impairment between the balance of antioxidants and pro-oxidants contributes to the elevation of blood pressure. Over generation of free radicals produces a decreased bioavailability of nitric oxide. Eventually, this will cause a rise in total peripheral resistance and lead to endothelial dysfunction. Noticeable symptoms are usually experienced when hypertension enters the advanced stage with lifelong health complications. Hypertensive patients are required to take medications for indefinite period of time to prevent further deterioration. Many of these therapeutic agents are costly and associated with unwanted side effects. Curcuma longa (CL) or turmeric is one of the alternative herbs which confers medicinal properties. This review aims to summarise the effects of CL and its active constituents on blood pressure derived from preclinical and clinical published articles. Studies documented that CL and its active constituents could reduce blood pressure. These were achieved by antioxidant, anti-inflammatory activity, calcium (II) ion concentration interference, β2-adrenergic receptor activation, and renin-angiotensin system inhibition. There is a prospect for CL in the management of hypertension. However, limited researches of CL have been conducted on human. Thus, more well-planned studies should be carried out to ascertain its effectiveness.

CURCUMA LONGA IN STROKE

Antioxidants have shown great promise in stroke prevention. Diarylheptanoids (also known as diphenylheptanoids) are a small class of plant secondary metabolites that possess antioxidant activity greater than that of α-tocopherol. Curcumin is the best known member and is mainly extracted from turmeric. This study aimed to explore whether curcumin has a preventive effect on stroke.

II. CONCLUSION

Curcumin has received worldwide attention for its multiple health benefits, which appear to act primarily through its anti-oxidant and anti-inflammatory mechanisms. These benefits are best achieved when curcumin is combined with agents such as piperine, which increase its bioavailability significantly. Research suggests that curcumin can help in the management of oxidative and inflammatory conditions, metabolic syndrome, arthritis, anxiety, and hyperlipidemia. It may also help in the management of exercise-induced inflammation and muscle soreness, thus enhancing recovery and subsequent performance in active people. In addition, a relatively low dose can provide health benefits for people that do not have diagnosed health conditions.

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