



Review Article

Pharmacological Effects of *Curcuma longa* and Its Bioactive Constitute Curcumin
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ABSTRACT

Curcuma longa (Turmeric) belongs to the family Zingiberaceae, commonly used as a spice, pigment and additive also are one of the most important ingredients in the Indian subcontinent. In recent years' research revealed several important functions of it. Among those being investigated is Turmeric. The aim of this review is to summarize the chemistry, referend, formulations of curcuminoids and their biological activities and provides an update mainly on the pharmacological activities of the Turmeric, its extracts and credible medicinal applications of Turmeric, along with their safety evaluation. Its most important active ingredient is curcuminoids. Which are phenolic compounds and volatile oils being also present in turmeric are known for their functional and nutraceutical properties. Various preclinical cell culture and animal studies suggest that curcuminoids have extensive biological activity as antioxidants, neuroprotective, antitumor, anti-inflammatory, anti-acidogenic, radioprotective, and arthritis. Different clinical trials also suggest a potential therapeutic role for curcuminoids in numerous chronic diseases like colon cancer, lung cancer, breast cancer, inflammatory bowel diseases. Nowadays, several drugs have been developed deriving from traditional products, and current drug research is actively investigating the possible therapeutic roles of many Ayurvedic and Traditional Indian medicinal therapies. Health benefits attributed to curcuminoids have resulted in their comprehensive utilization in food and pharmaceutical formulations.

INTRODUCTION

BIOACTIVE COMPONENTS OF TURMERIC

Curcuma longa is known to contain certain beneficial constituents such as flavonoids, curcuminoids, and phenolic acids, which are effective against many diseases [10]. Among the curcuminoids, Curcumin (CUR), demethoxycurcumin (DMC), and bisdemethoxycurcumin (BDMC) show anti-cancer, inflammation lowering, and free radical scavenging properties [11]. The most abundant curcuminoid is diferulomethane, also known as curcumin, comprising 60-70% of raw *Curcuma*. This compound is significantly known to have therapeutic benefits. Besides these, other little bioactive substances include volatile oils

like zingiberene, atlantone and turmerone, carbohydrates, proteins, and certain gums [12]. Among the nutrients present, macronutrients such as carbohydrates count for 40%, proteins for 17%, fats for 5%, and micronutrients like Mg and Fe constitute just 3% of the *Curcuma* extract. An abundant amount of fiber was also found present in addition to other nutrients [13]. TSO, which is also called Turmeric spent oleoresin, is generally discarded like rubbish in industries. It is made after the removal of curcuminoids from turmeric. Recent research on this industrial refuse shows its excellent therapeutic properties against various diseases. The product mainly

contains polyphenols and other beneficial compounds, which make it a powerful microbe killer, free radical scavenger, and food safety agent. Bisdemethoxycurcumin, ferulic acid, dihydro curcumin, bisabolocurcumin ether, myristicin, furanodiene, cyclocurcumin, terpecurcumin O, curcumin, and 6-methoxy-2-[2-(3 methoxyphenyl) ethyl] are the major chemical substances commonly found in this golden spice [14].

Anti-Obesity Effect of Curcumin

These days' obesity is a worldwide serious global issue according to high statistics obesity data; its prevalence is more common in developing countries because of obesity death rate is increasing day by day and also affecting people's health [15]. It's a serious health factor that causes many ailments and emergency medical conditions like heart attack, high blood pressure, atherosclerosis [16]. According to WHO high amount of fat stored in the body and BMI of more than 25 is known as overweight, and more than 29 is known as obesity [17]. These days, a phytochemical called Curcumin is popular concerning those who are obese and have metabolic issues [18]. Curcumin impacts white adipose tissue to decrease fiery macrophage invasion, control fiery adipokine synthesis, and extend adiponectin generation; it has antioxidant properties [19]. Anti-inflammation results of curcumin and curcuminoids within the obesity type 1 or types two states are delivered by regulating a great range of atomic targets [20]. In fat tissue and many other types of cells and tissues, curcumin synchronizes the DNA-binding and conversion actions of the inflammation factors NF- κ B and AP-1, receptive oxygen species, and inhibits Mitogen-activated protein kinase created by inflammatory provocation [21]. One study stated that Curcumin given in the meal at a dosage of 0.05 percent weight reduced, but bodyweight increased without altering food intake in mice fed a 22 percent high-fat diet for 12 weeks [22]. By Dual-energy X-ray absorptiometry, we can find bone density and body fat mass. Following curcumin therapy in high-fat-diet which is fed to mice, X-Ray absorptiometry shows the results in a reduction in body fat mass and % fat, corroborating earlier research that measured changes in body and organ mass by actual weighing, which yields the total mass but not necessarily the fat content [23]. Curcumin is shown to reduce intracellular cholesterol levels, inhibit fat buildup, and control metabolic activity. Curcumins control the expression of transcription factors involved in adipocyte and lipid synthesis. Curcumin therapy raised phospho-AMPK levels, decreased glycerol-3-phosphate acyltransferase, and enhanced carnitine palmitoyl-transferase 1A expression, resulting in more fat oxidation and far less fatty acid esterification [24].

Anti-diabetic Properties of Curcumin

Diabetes mellitus is one of the common diseases in which insulin is not working, or insulin is insufficient by which blood glucose level increases. It also affects the digestion of carbohydrates and fats due to this body energy becoming low [25]. It's more common in Asian states like China, India, and other countries, Brazil and America. The severity of diabetes in these countries highlights the large cases of retinopathy, nephropathy, and some heart attack cases as well [26]. In Brazil, the National Health Service policy stated extract of herbs cures lipid profile and insulin level of diabetes patient, phytotherapy is complimentary recommended for such cases [27]. This recommendation knowledge is based on clinical experimental evidence and positive results by health experts and researchers internationally [28]. Curcumin extracted from turmeric is a phytochemical that has been proved anti-diabetic in clinical studies, and in vitro studies show many benefits and potential effects on diabetes-related conditions [29]. Curcumin activates the plasma membrane and membrane of cell organelles of the pancreas to release insulin [30]. The three major bioactive components of turmeric that take a role in hyperglycemia to cure are curcumin, cumin aldehyde, cuminol; they improve the functioning of the pancreas insulin stimulating beta cells [31]. According to the Journal of the American College of Nutrition, adipose tissue releases leptin when its secretion increases, the apoptosis rate in pancreas beta cells increases, and it causes inhibitory effects on insulin function [32]. Interestingly, the effective properties of curcumin are observed both on the cell-cultured animals, and results are the same when it is practically observed on humans [33]. If we give a diabetic patient a curcumin capsule at a dose of 300mg / per day who is also obese, then the patient may reduce their BMI, LDL, fasting sugar, 17% blood glucose level will be maintained [34]. According to Toronto General Research Institute, diabetic patients' body weight decreases and body fat content in the high-fat diet; if a patient is taking a curcumin capsule daily, almost five experiments proved that it slows down adipose cells expansion [35].

Curcumin and Cardiovascular Diseases

Curcumin, the major curcuminoid found in the turmeric rhizome (*Curcuma longa*), has the property to reduce inflammation, inhibit oxidation, show anti-apoptotic and cardioprotective properties [36]. Curcumin has been shown to lower the production of reactive oxygen species, exert expression to protect cells and their properties, and reduce oxidative stress and inflammation in several in vitro and in vivo investigations [47]. In myocardial ischemia, several pathways are engaged, and their role in ischemic myocardial cell injury and death has been well-characterized at the molecular level. For example, in

cardiac ischemia, the production of reactive oxygen species becomes high as feedback of the loss of oxygen the substrate's surface energy. Increased reactive oxygen stress can cause cardiomyopathy deformities and other sub-cellular structure disturbances because high oxygenated stress damages lipid, protein, and DNA [38]. In comparison to the negative control groups, Liu et al. found that giving rats curcumin (10, 20, or 30 mg/kg/d) as a complement reduces oxidative stress (3-fold) and infarct size (2.5-fold) [39]. In the case of post-Myocardium Infarction, which is very common these days in every developed country, it could be the result of a high level of apoptosis; in other words, it is also called the end of cell cycle or cell death because, at the most damaged part in myocardium infarction reports of apoptosis seen abnormal, early treatment of ventricles can prevent heart attack. Curcumin can decrease the apoptosis process, regarded as one of the most important goals for avoiding heart failure development in individuals who have had a cardiac attack. In the most frequently used inbred strain of mice, the C57 black 6 (C57BL/6) mice have consistently shown that curcumin may have cardiac myocytes counter normal cell death induced by deficiency of oxygen [40]. Curcumin protects against cancer via up-regulating miR-7a/b genes; these genes protect the individual from cardiomyocyte in ischemia, according to the researchers. Curcumin has also been shown to affect the SIRT3 genes (regulate cardiac energy) reaction pathway, lowering the activity of other apoptosis indicators, including protein Bax, a large group of proteins that control APOPTOSIS acetylated superoxide dismutase 2, an enzyme that reduces oxygenated stress [41].

Curcumin link to Inflammatory Bowel Disease

In the gut, microflora bacteria digest macronutrients and make intestines healthy when there is any disruption of this bacteria or any other environmental negative factor or foreign particle attack on the gastrointestinal tract, intestinal bowel disease develops [42]. Curcumin is proved safe to be used in many clinical trials; it is stated that it can cure irritable bowel disease (IBD). After much research, it is demonstrated that inflammation of the gastrointestinal tract, such as inflammatory bowel disease, e.g., Crohn's disease, ulcerative colitis, may cause colon cancer [43]. In 2012, the American Journal explained curcumin's reaction with inflammatory bowel disease; a small experiment was done on 9 patients [44]. Curcumin dose of 550 mg given twice a day for one month then next month they give the same dose of curcumin three times daily for a month to 5 patients who are already suffering from inflammatory bowel disease and taking corticosteroids therapy; after this experiment, the patient result seems positive condition was improved as compared to before

experiment. Another four patients out of nine stopped taking their corticosteroids therapy because they cure only with curcumin Phytotherapy. A patient with Crohn's disease takes curcumin therapy to follow up for one month and cure symptoms like body pain, bloating, dehydration, and normal stools. curcumin is an antioxidant that cures inflammation of the gastrointestinal tract and is used in multiple pharmacological experiments [45]. In another research, a patient having ulcerative colitis disease with multiple symptoms like abdominal cramps, blood in stools, weakness, bloating, given 500mg dose of curcumin per day with a combination of prednisone by the oral route of this phytotherapy feeding, express positive results after one year of this treatment, patient report no blood in stools no cramps [46].

Antimicrobial Activity

Turmeric is used as a food preservative [47]; spices have a significant hand in the pharmaceutical industry and are also shown to extend the shelf life of food due to its antimicrobial activities. Antimicrobial activities range from acting against total aerobic mesophilic bacteria (TAMB) and total aerobic psychotropic bacteria (TAPB) [48]. Streptococcus, Staphylococcus, Klebsiella pneumonia, Helicobacter pylori, Bacillus subtilis, Vibrio cholera. It has been effective against Streptococcus is also in line with other studies [49]. An inhibition zone is seen against E. coli and S. Aureus, thus essential in healing wounds. Turmeric is also working in sync with various anti-biotics such as ampicillin oxacillin and norfloxacin [50]. Farming turmeric in nutrient-rich soils would contribute to the expansion of sustainable and industrial agriculture, leading to massive employment and, therefore, improving the country's economic status, as seen in Nsukka [51].

C O N C L U S I O N S

Turmeric is a one-of-a-kind source of a number of chemical compounds that are involved in a variety of biological processes. Although several studies have been conducted on turmeric, further research is required to determine its other medicinal properties in the fight against illness. A drug development program should be initiated to create current medications. While crude extracts of the plant's leaves or rhizomes have medicinal properties, modern drugs can only be developed following extensive investigation of the plant's pharmacotherapeutics, bioactivity, mechanism of action, and toxicities, as well as following proper standardization and clinical trials. As the worldwide landscape is shifting toward the use of non-toxic plant products with traditional therapeutic uses, it is critical to focus the creation of new pharmaceuticals derived from C. longa for the management of various illnesses. Additional research on C. longa is necessary to

elucidate the hidden regions and their practical therapeutic uses that can benefit humanity

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