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Exploring knowledge about medicinal uses of curcumin

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Abstract

Turmeric, a spice long known for its medicinal properties, has been popularized by the medical/scientific community and culinary enthusiasts as a significant source of the polyphenol curcumin. It helps control oxidation and inflammation, metabolic syndrome, arthritis, stress and hyperlipidemia. It may also help manage exercise-related pain and muscle aches, thus improving recovery and performance in active people. Additionally, small doses of the complex may provide health benefits to undiagnosed individuals. Many of these benefits can be attributed to its antioxidant and anti-inflammatory properties. Taking curcumin alone does not provide health benefits due to its poor bioavailability; This appears to be mainly due to poor absorption, rapid metabolism, and rapid elimination. There are many ingredients that can increase bioavailability. For example, pipeline, the main active ingredient in black pepper, has been shown to increase bioavailability by 2000% when combined with curcumin. The combination of curcumin with medication has many health benefits. The purpose of this review is to provide a brief overview of the extensive research on the health benefits of curcumin.

Keywords: curcumin, turmeric, antioxidant, anti-inflammatory, polyphenols

Introduction

Curcumin is known and used in many forms around the world and has many health benefits. For example, in India, turmeric (containing curcumin) is used in curry; In Japan, it is added to tea; Used in cosmetics in Thailand; It is used as a colorant in China; In Korea, it is used in cosmetics. It is added to the drink; It is used as a food product in Malaysia; It is used as an anti-inflammatory drug in Pakistan; In the United States, it is used in mustard, cheese, cream, and mashed potatoes. Capsules and powder data. Curcumin is available in many forms, including capsules, tablets, creams, drinks, soaps and cosmetics. Curcumin is approved as "Generally Recognized as Safe" (GRAS) by the US Food and Drug Administration (FDA) , and clinical studies have shown it to be safe and effective even at doses of 4000 and 8000 mg/m . day and consumed approximately 12,000 mg/day of three curcuminoids at 95% concentration: curcumin, bisdemethoxy curcumin, and demethoxy curcumin . The purpose of this review is to provide a brief overview of the extensive research on the health benefits of curcumin. Because of the limited available data, we chose to focus on results related to specific health outcomes and outcomes in healthy populations rather than examining large-scale data on diseases such as cancer and other diseases. For a comprehensive review of curcumin's effects on cancer, see. Kunnumakkara et al. 2017.

Turmeric is a spice approved by the medical/scientific community as well as the culinary community. Turmeric is a perennial rhizome herbaceous plant belonging to the Zingiberaceae (Curcuma longa) family . The medicinal properties of turmeric (a source of curcumin) have been known for thousands of years. However, the ability to accurately determine activity and identify bioactive substances has only recently been investigated . Curcumin (1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione), also known as diferuloylmethane, is a product of the rhizome of Curcuma longa. Curcuma plants. .

Turmeric has been traditionally used as a medicinal herb in Asian countries for its antioxidant, anti-inflammatory , antimutagenic, antimicrobial and anticancer properties.

Mechanism of action

Antioxidants

Antioxidant and anti-inflammatory properties are the two main mechanisms that explain many of the effects of curcumin on the various conditions discussed in this review]. Curcumin has been shown to improve markers of oxidative stress [23]. There is evidence that antioxidants such as superoxide dismutase (SOD) may increase blood sugar levels. A recent review and meta-analysis of randomized controlled data on the effectiveness of curcumin supplementation on oxidative stress did not show any effect of curcumin supplementation. Effects on overall oxidative stress (including plasma activity of SOD and catalase) have not been investigated. Effects such as blood sugar levels of glutathione peroxidase (GSH) and lipid peroxides [23]. All studies included in the meta-analysis used some formulation to overcome bioavailability issues, with piperine used in four of the six studies. Curcumin's effect on free radicals is achieved through different mechanisms. It can scavenge many types of free radicals, such as reactive oxygen species and reactive nitrogen species (ROS and RNS, respectively) [25]; It can regulate the activity of GSH, catalase and SOD enzymes, which have the function of neutralizing free radicals. [21,22]; Additionally, it can inhibit ROS-producing enzymes such as lipoxygenase/cyclooxygenase and xanthine hydrogenase/oxidase [21]. Additionally, curcumin is a lipophilic compound, making it effective against peroxyl radicals, and therefore, like vitamin E, curcumin is considered an antioxidant. 2.2. Immunity Oxidative stress is associated with many diseases and its pathological process is associated with inflammation and one type of disease can easily trigger another. In fact, it is known that inflammatory cells cause oxidative stress by secreting many reactive chemicals in the inflammation area, which shows the relationship between oxidative stress and inflammation (28). In addition, various reactive oxygen/nitrogen species can initiate intracellular signaling cascades, thereby increasing gene expression. Inflammation has been described as a developmental process in many diseases and conditions [10,19,29,30]. These diseases include Alzheimer's disease (AD), Parkinson's disease, multiple sclerosis, epilepsy, brain disease, heart disease, metabolic syndrome, cancer, allergy, asthma, bronchitis, colitis, arthritis, renal ischemia, psoriasis, diabetes, obesity, depression, includes fatigue. . and transmission of the immunodeficiency virus AIDS

Anti-inflammatory

Tumor necrosis factor alpha (TNF-α) is an important therapeutic effect of inflammation in many diseases, an effect that occurs by activating the transcription factor nuclear factor (NF)-κB. Although TNF-α is considered the most potent inhibitor of NF-κB, TNF-α expression is also regulated by NF-κB. In addition to TNF-α, most inflammatory cytokines also activate NF-κB; Gram-negative bacteria; many pathogenic bacteria; Environmental pollution; chemical, physical, physical and emotional;

hyperglycemia; fatty acids; ultraviolet radiation; cigarettes; and other causal factors. Therefore, drugs that downregulate NF-κB and products regulated by NF-κB have the potential to be effective in many of these diseases. Curcumin has been shown to block increased NF-κB activation by several different inflammatory stimuli [10]. Curcumin has also been shown to inhibit inflammation through several different mechanisms beyond this review, supporting its mechanism of action as an anti-inflammatory agent

Arthritis

One disease associated with both acute and chronic pain is osteoarthritis (OA), a joint disease. It affects more than 250 million people worldwide, leading to increased healthcare costs, impairment of activities of daily living (ADLs), and ultimately decreased quality of life [31, 32]. Although OA was once thought of as a primarily degenerative and non-infectious disease, it is now thought to be inflammatory with high levels of cytokines and may be associated with pain throughout the body [33,34]. Although there is no cure, there are many medications available; However, many methods are costly and have negative side effects. Therefore, there is interest in alternative treatments such as diet and herbs.

Conclusion

Curcumin has gained worldwide attention for its many health benefits, which appear to work mainly thanks to its antioxidant and anti-inflammatory properties. The best results are achieved when curcumin is combined with drugs such as piperine, thus increasing its bioavailability. Research shows that curcumin helps control oxidation and inflammation, metabolic syndrome, arthritis, anxiety, and hyperlipidemia. It may also help manage exercise-related pain and muscle soreness, thus improving recovery and post-exercise performance in active individuals. Low doses may also provide health benefits to undiagnosed people.

Metabolic Syndrome

The idea that curcumin can attenuate systemic inflammation has implications beyond arthritis, as systemic inflammation has been associated with many conditions affecting many systems. One such condition is Metabolic syndrome (MetS), which includes insulin resistance, hyperglycemia, hypertension, low high-density lipoprotein cholesterol (HDL-C), elevated low-density lipoprotein cholesterol (LDL-C), elevated triglyceride levels, and obesity, especially visceral obesity. Curcumin has been shown to attenuate several aspects of MetS by improving insulin sensitivity [43,44], suppressing adipogenesis and reducing elevated blood pressure], inflammation , and oxidative stress [48,49]. In addition, there is evidence that curcuminoids modulate the expression of genes and the activity of enzymes involved in lipoprotein metabolism that lead to a reduction in plasma triglycerides and cholesterol [50,51,52] and elevate HDL-C concentrations [53]. Both overweight and obesity are linked to chronic low-grade inflammation; although the exact mechanisms are not clear, it is known that pro-inflammatory cytokines are released. These cytokines are thought to be at the core of the complications associated with diabetes and cardiovascular disease. Therefore, addressing inflammation is important. In a randomized double-blind placebo-controlled trial with a parallel-group design, 117 subjects with MetS received either 1 g curcumin plus 10 mg piperine to increase absorption or a placebo plus 10 mg piperine for eight weeks. Within-group analysis revealed significant reductions in serum concentrations of TNF-α, IL-6, transforming growth factor beta (TGF-b), and monocyte chemoattractant protein-1 (MCP-1) following curcumin supplementation ($p < 0.001$). In the placebo group, serum levels of TGF-b were decreased ($p = 0.003$) but those of IL-6 ($p = 0.735$), TNF-α ($p = 0.138$), and MCP-1 ($p = 0.832$) were not. Between-group comparison suggested significantly greater reductions in serum concentrations of TNF-α, IL-6, TGF-b, and MCP-1 in the curcumin versus the placebo group ($p < 0.001$). Apart from IL-6, changes in other parameters remained statistically significant after adjustment for potential confounders, including changes in serum lipids and glucose levels, as well as the baseline serum concentration of the cytokines. The results of this study suggest that curcumin supplementation significantly decreases serum concentrations of pro-inflammatory cytokines in subjects with MetS [11]. In addition, the study looked at the cholesterol-lowering properties and found that curcuminoids were more effective than the placebo in reducing serum LDL-C, non-HDL-C, total cholesterol, triglycerides, and lipoprotein a (Lp(a)), in addition to elevating HDL-C concentrations. However, changes in serum LDL-C levels were found to be comparable between the study groups. The effects of curcuminoids on triglycerides, non-HDL-C, total cholesterol, and Lp(a) remained significant after adjustment for baseline values of lipids and body mass index [54]. From the same study, the authors also reported markers of oxidative stress. There was a significant

Improvement in serum SOD activities ($p < 0.001$) and reduced MDA ($p < 0.001$) and C-reactive protein (CRP) ($p < 0.001$) concentrations in the group receiving the curcumin with piperine compared to the placebo group. Their secondary purpose was to perform a meta-analysis of data from all randomized controlled trials in order to estimate the effect size of curcuminoids on plasma CRP concentrations. Quantitative data synthesis revealed a significant effect of curcuminoids vs. placebo in reducing circulating CRP concentrations The authors concluded that short-term supplementation with a curcuminoid-piperine combination significantly improves oxidative and inflammatory status in patients with MetS. Curcuminoids could therefore be regarded as natural, safe, and effective CRP-lowering agents

Inflammatory cytokines were also measured in the above study. Mean serum IL-1β ($p = 0.042$), IL-4 ($p = 0.008$), and vascular endothelial growth factor (VEGF) ($p = 0.01$) were found to be significantly reduced by curcumin therapy. In contrast, no significant difference was observed in the concentrations of IL-2, IL-6, IL-8, IL-10, interferon gamma(IFNγ), epidermal growth factor (EGF), and MCP-1. The authors suggest that the findings indicate that curcumin may exert immunomodulatory effects via altering the circulating concentrations of IL-1β, IL-4, and VEGF

In a randomized double-blind placebo-controlled crossover trial, 36 obese adults received either 1 g curcumin and 10 mg piperine or a placebo for 30 days followed by a two-week washout period, after which they received the other treatment. A significant reduction in serum triglyceride concentrations was observed, but the treatment did not have a significant influence on serum total cholesterol, LDL-C, HDL-C, and high-sensitivity C-reactive protein (hs-CRP) concentrations, nor on body mass index (BMI) and body fat. The authors suggest that the short supplemental period, lack of control of diet, and the low supplemental dose may explain why these results conflict previous reports

Healthy People

To date, the majority of curcumin studies in humans have been in populations with existing health problems. Perhaps this is because studies on healthy people can be challenging in that benefits may not be as immediate and measurable if biomarkers are normal at baseline. Therefore, following subjects over time may provide the best insight into any potential health benefits in healthy people, although such studies can be time-consuming and costly. Making cross-comparisons between the few studies that have been done can be difficult because studies have used varying doses, often as high as 1 g [57,58]. It should be noted that this would be considered a high dose only because it is higher than what most people could obtain from consuming the spice itself [49]. One study on healthy adults aged 40–60 years used an 80 mg/day dose of a lipidated form of curcumin. Subjects were given either curcumin (N = 19) or a placebo (N = 19) for four weeks. The treatment was 400 mg powder per day containing 80 mg curcumin. Blood and saliva were taken before and after the four weeks. Curcumin significantly lowered triglyceride levels but not total cholesterol, LDL, or HDL levels. There was a significant increase in nitrous oxide (NO) and in soluble intercellular adhesion molecule 1 (sICAM), a molecule linked to atherosclerosis. Inflammation-related neutrophil function increased, as measured by myeloperoxidase concentration, but c-reactive protein and ceruloplasmin did not. There was a decrease in salivary amylase activity, which can be a marker of stress, and an increase in salivary radical scavenging capacities and plasma antioxidant enzyme catalase, but not in super oxide dismutase or glutathione peroxidase. In addition, there was a decrease in beta amyloid plaque, a marker of brain aging, and in plasma alanine amino transferase activities, a marker of liver injury. This indicates that a relatively low dose of curcumin can provide health benefits for people that do not have diagnosed health conditions

In a randomized double-blind placebo-controlled trial, the acute (1 and 3 h after a single dose), chronic (four weeks), and acute-on-chronic (1 and 3 h after single dose following chronic treatment) effects of solid lipid curcumin formulation on cognitive function, mood, and blood biomarkers in 60 healthy adults aged 60–85 years were examined. The curcumin formulation was 400 mg, approximately 80 mg curcumin in a solid lipid formulation with the remaining weight comprised of commonly used pharmaceutical excipients and small amounts of other curcuminoids present in turmeric extract. One hour after administration, curcumin significantly improved performance on sustained attention and working memory tasks,

compared with the placebo. Working memory and mood (general fatigue and change in state calmness, contentedness, and fatigue induced by psychological stress) were significantly better following chronic treatment. A significant acute-on-chronic treatment effect on alertness and contentedness was also observed. Curcumin was associated with significantly reduced total and LDL cholesterol

Another study examined whether supplementation with curcumin and Boswellia serrata (BSE) gum resin for three months could affect plasma levels of markers of oxidative stress, inflammation, and glycation in 47 male healthy master cyclists. All subjects were instructed to follow a Mediterranean diet with 22 subjects receiving a placebo and 25 receiving 50 mg of turmeric, corresponding to 10 mg of curcumin, as well as 140 mg of Boswellia extract, corresponding to 105 mg of Boswellia acid for 12 weeks. There was a positive effect observed on glycoxidation and lipid peroxidation in healthy male master athletes This study indicates the potential for combining curcumin with other agents to achieve health benefits.

Perhaps another challenge to interpreting studies on healthy people is determining the definition of healthy, especially when considering that people who do not have an official diagnosis may still participate in activities or experience situations whereby they challenge their daily physiological homeostasis. For example, an exercise routine that one is not used to can cause inflammation, oxidative challenges, and resulting soreness. In a recent study, 28 healthy subjects that did not participate in resistance training were randomly assigned to receive either curcumin (400 mg/day) for two days before and four days after participating in an eccentric exercise designed to induce muscle soreness. Curcumin supplementation resulted in significantly smaller increases in creatine kinase (CK) (−48%), TNF-α (−25%), and IL-8 (−21%) following exercise compared to the placebo. No significant differences in IL-6, IL-10, or quadriceps muscle soreness between conditions were observed. The findings demonstrated that the consumption of curcumin reduced biological inflammation, but not subjective quadriceps muscle soreness during recovery from exercise. This may help to decrease recovery time, thus improving performance during subsequent exercise sessions

In a similar randomized placebo-controlled single-blind pilot trial, 20 male healthy, moderately active volunteers were randomized to receive either 1 g curcumin twice daily (200 mg curcumin twice a day) or a placebo 48 h prior to and 24 h after a downhill running test. Subjects in the curcumin group reported significantly less pain in the right and left anterior thigh. Significantly fewer subjects in the curcumin group had MRI evidence of muscle injury in the posterior or medial compartment of both thighs. Increases in markers of muscle damage and inflammation tended to be lower in the curcumin group, but significant differences were only observed for interleukin-8 at 2 h after exercise. No differences in markers of oxidative stress and muscle histology were observed. These results further support that curcumin may be beneficial to attenuate exercise-induced muscle soreness (DOMS)

A study by Delecroix et al. offers further support. They reported that 2 g of curcumin and 20 g of piperine supplementation can help offset some of the physiological markers of muscle soreness after an intense workout in elite rugby players

In addition to acute physical stresses, humans may also suffer from periods of anxiety or depression which are sub clinical, but may still benefit from treatments that can decrease the symptoms. In a randomized double blind cross-over trial, 30 obese adults received curcuminoids (1 g/day) or a placebo for 30 days, and then after a two-week washout period, crossed over to the alternate regimen. The curcumin was a 500-mg C3 Complex® (standardized powder extract obtained from Alleppey finger turmeric containing a minimum 95% concentration of three curcuminoids: curcumin, bisdemethoxycurcumin, and demethoxycurcumin) plus 5 mg bioperine® per serving to enhance absorption. Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI) scales were filled out for each participant at baseline and after four, six, and 10 weeks of supplementation. Mean BAI score was found to be significantly reduced following curcumin therapy (p =

0.03). However, curcumin supplementation did not exert any significant impact on BDI scores. This study suggests that curcumin has a potential anti-anxiety effect in otherwise healthy obese people

1. Side Effects

Curcumin has a long established safety record. For example, according to JECFA (The Joint United Nations and World Health Organization Expert Committee on Food Additives) and EFSA (European Food Safety Authority) reports, the Allowable Daily Intake (ADI) value of curcumin is 0–3 mg/kg body weight Several trials on healthy subjects have supported the safety and efficacy of curcumin. Despite this well-established safety, some negative side effects have been reported. Seven subjects receiving 500–12,000 mg in a dose response study and followed for 72 h experienced diarrhea, headache, rash, and yellow stool In another study, some subjects receiving 0.45 to 3.6 g/day curcumin for one to four months reported nausea and diarrhea and an increase in serum alkaline phosphatase and lactate dehydrogenase contents

2. Conclusions

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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