POTENTIAL HEALTH BENEFITS OF TURMERIC

Domina Petric, MD

ABSTRACT

Turmeric has been scientifically investigated for its potential anti-inflammatory, antioxidant, neuroprotective and cardiovascular-protective effects. Available evidence supports the thesis that turmeric might have such effects, mostly attributable to curcumin, which has poor bioavailability, and therefore, it should be combined with piperine in order to achieve better pharmacokinetic profile. Data from clinical trials are scarce, but signalize that curcumin may be useful as a nutritional support in various diseases, such as depression, neurovascular and cardiovascular disorders, but further clinical research is mandatory before any firm clinical-nutritional recommendations can be made.

KEYWORDS: turmeric; anti-inflammatory; antioxidant, neuroprotective

INTRODUCTION

Turmeric has been used in India both as a spice and as a medicinal herb based on experience, however, there has been also an increasing scientific interest for the investigation of turmeric’s compounds, curcuminoids, that could exert medicinal properties. It seems that the most important of curcuminoids may be curcumin. Nutritional supplements based on turmeric should contain piperine, which is derived from black pepper, because it enhances the absorption of curcumin by 2000% [1, 2], and therefore, enhances its potential health benefits. Curcumin alone has not been approved as a clinical drug candidate because of its poor pharmacokinetics [3]. Here author summarizes potential health benefits of turmeric, based on the available up-to-date scientific data, that may include anti-inflammatory and anti-oxidant activity, potential neuroprotective and cardiovascular-protective effects.

POTENTIAL ANTI-INFLAMMATORY PROPERTIES

Results of an in vitro study showed that curcumin exerts potent anti-inflammatory and antiproliferative effects and these effects were comparable to those of resveratrol, celecoxib, and tamoxifen [4]. In another in vitro study researchers demonstrated that curcumin is a potent inhibitor of nuclear factor-kappa B (NF-κB) activation [5], which regulates multiple
immunological aspects. It is also a mediator of various inflammatory responses, including the induction of pro-inflammatory genes expression and inflammasome regulation [6]. Therefore, inhibition of different steps of NF-κB signaling has been investigated as a new approach for anti-inflammatory therapy. Results of an in vitro study using HT-29 human colon cancer cells showed that curcumin inhibited the cancer cell growth in a manner that is concentration and time-dependent. Further analyses showed that it inhibited mRNA and protein expression of cyclooxygenase (COX)-2 [7]. Human clinical trials conducted up to year 2003 showed that curcumin is generally safe and that it may exert anti-inflammatory activity in vivo as well [8]. Results of a clinical study (RCT) on 50 patients suffering from non-alcoholic fatty liver disease (NAFLD) showed that curcumin supplementation was associated with significant decrease in both hepatic fibrosis (p < 0.001), and NF-κB activity (p < 0.05) as compared with the baseline, however hepatic steatosis and serum level of liver enzymes, as well as tumor necrosis factor-α (TNF-α) levels were significantly reduced in both curcumin and placebo group (p < 0.05), suggesting that curcumin supplementation along with lifestyle modifications was not superior to lifestyle modification alone regarding anti-inflammatory effects [9]. Although this study did not show the superiority of curcumin, it shows that curcumin can lower the NF-κB activity in vivo. It should also be noted that the supplement used in this study did not contain piperine, which may be associated with significantly lower bioavailability of curcumin and therefore, poorer results in comparison with placebo.

POTENTIAL ANTIOXIDANT ACTIVITY

An in vitro study showed that only curcumin from all tested curcuminoids showed chain-breaking antioxidant activity [10]. A study investigating toxicity of mercury on rats showed that treatment with curcumin exhibited anti-oxidant protective activities, and there was a reversion of mercury induced-serum biochemical changes as well as a decrease of mercury concentration in tissues. However, histopathological alterations of the liver and kidney tissues caused by mercury were irreversible [11]. Despite the fact that curcumin was ineffective in reversing liver and kidney tissue damage caused by mercury, this study may be understood as a potentially relevant proof that curcumin has indeed potent anti-oxidant activity, which may be further investigated in the context of at least some protection against mercury intoxication. A study on male rats exposed to subchronic doses of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) showed that treatment with curcumin decreased malondialdehyde (MDA) levels in all tissues; increased superoxide dismutase (SOD) activity in liver, kidney, and brain; increased catalase activity of hearth and glutathione peroxidase activity in heart and brain.
Results also showed that curcumin partially eliminated the effect of TCDD in decreasing body weight gain and it also partially reversed toxic effects of TCDD on reproductive organ weight, sperm concentration and motility [12]. This study shows that curcumin may be potentially protective in the case of TCDD toxicity, which may be attributable to its antioxidant effects. In an \textit{in vitro} study, curcumin inhibited both hydrogen peroxide and TNF-alpha mediated activation of NF-κB activity, activator protein (AP)-1 activation and interleukin (IL)-8 release in A549 cells. Electron paramagnetic resonance showed that curcumin interacts directly with superoxide anion and hydroxyl radical. Authors concluded that curcumin may act as oxygen radical scavenger, antioxidant through modulation of glutathione levels, and as an anti-inflammatory agent inhibiting IL-8 in lung cells [13]. Results of an RCT including 60 patients with chronic knee osteoarthritis showed that prostaglandin (PGE)-2 was decreased significantly in both the group receiving daily turmeric extract, ginger and black pepper, as well as in the group of patients receiving Naproxen capsules for 4 weeks (p <0.001) [14], showing potential non-inferiority of turmeric in combination with ginger and black pepper (curcumin-piperine complex) as an anti-inflammatory and anti-oxidant agent.

\textbf{POTENTIAL NEUROPROTECTIVE EFFECTS}

Results of a study on rats showed that chronic curcumin administration reversed performance deficits and various adverse physiological effects caused by chronic stress. Researchers also found that stress-associated decrease in brain-derived neurotrophic factor (BDNF) level and reduction of pCREB/CREB (phosphorylated cAMP response element-binding protein to cAMP response element-binding protein) ratio were blocked by curcumin [15]. A study on adult male Wistar Kyoto rats (depression model) showed that curcumin was associated with dose-dependent reduction of immobility in forced swim test (FST) in acute and chronic conditions, without any significant effects on open field locomotor activity (OFLA). Effects of higher dose of chronic curcumin administration on FST showed a one week-lasting post-dose effects. Chronic curcumin administration also resulted in dose-dependent increase of hippocampal BDNF [16]. Both animal studies show that curcumin has a potentially neuroprotective (neurotropic) effects that could be important in the prevention and treatment of detrimental effects of acute and chronic stress conditions as well as depression. A study on aged rats showed that 6-12-week diets fortified with curcumin enhanced both non-spatial and spatial memory, as well as dentate gyrate cell proliferation as compared to control diet rats. Further analysis of underlying mechanistic pathways indicated the existence of both the neurogenesis-enhancing and cognition-enhancing potential of curcumin [17]. Results of a
study investigating the effects of curcumin supplementation on cognitive impairment evaluated by Morris-water maze (MWM) as well as the oxidative stress induced by aging in female rats, showed that curcumin supplementation increased the number of platform crossings and decreased MDA levels in brain tissue. Researchers concluded that curcumin supplementation was associated with improvements of cognitive functions by means of decreasing lipid peroxidation in brain tissue [18]. Results from above-mentioned animal studies show that curcumin supplementation may be associated with better cognitive performance, improvements in memory and/or prevention of memory losses associated with various stress conditions as well as with neuroprotective and neurotropic effects.

Results of an RCT on 80 patients suffering from diabetes with peripheral polyneuropathy showed that there was a significant reduction in both the mean score of depression and anxiety in the group of patients receiving 80 mg of nano-curcumin during 8 weeks compared with placebo group [19]. Results of another RCT including 60 patients diagnosed with major depressive disorder (MDD) showed that there were improvements (but not statistically significant) of depressive symptoms measured with Hamilton Depression Rating Scale (HAM-D17) in a group of patients receiving both 20 mg of fluoxetine and 1000 mg of curcumin in the comparison with patients who received fluoxetine or curcumin alone [20], indicating that curcumin may be considered as a generally safe nutritional support in the treatment of depression. Results of RCT on 123 patients suffering from MDD showed that combination of curcumin and saffron supplementation was associated with improvements in depressive symptoms in comparison with placebo, although the difference was not statistically significant [21].

**POTENTIAL CARDIOVASCULAR PROTECTIVE EFFECTS**

Results of an RCT on 32 postmenopausal women suggest that curcumin together with aerobic exercise training may increase flow-mediated dilation in postmenopausal women (synergistic effect), which could further potentially improve the age-related decline in endothelial function [22]. In another study researchers found that two capsules containing curcumin in a dose of 150 mg twice daily had favorable effect on endothelial dysfunction that was comparable to that of atorvastatin, and was related to reductions in inflammatory cytokines and markers of oxidative stress [23]. Results of an RCT on 121 patients undergoing coronary artery bypass grafting (CABG) showed that the incidence of in-hospital myocardial infarction was significantly decreased in patients receiving curcumin supplementation in comparison to
placebo group (adjusted hazard ratio 0.35, 0.13 to 0.95, p = 0.038). In addition to that, postoperative C-reactive protein (CRP), MDA, and N-terminal pro-B-type natriuretic peptide levels were lower in curcuminoid group [24]. Authors of a systematic review article concluded that turmeric and curcumin show protective effects regarding the risk of cerebrovascular disease (CVD) development by improving serum lipid levels [25]. Therefore, curcumin may be considered as a complementary prophylactic nutritional support in the prevention of CVD. Authors of a meta-analysis concluded that nano-curcumin supplementation may decline cardiovascular disease risk by improving glycemic and lipid profiles, inflammation, and systolic blood pressure [26]. Findings of RCT on 42 middle-aged females suffering from hyperlipidemic diabetes mellitus type 2 showed that aerobic training with turmeric supplementation (synergistic effect) may improve metabolic status, oxidative stress biomarkers, and high sensitivity CRP more effectively than aerobic training or turmeric supplementation alone. Results were statistically significant [27]. Results of another RCT showed that turmeric supplementation showed favorable cost-effectiveness in decreasing the levels of triglycerides and HOMA-IR (homeostatic model assessment for insulin resistance) [28]. A study showed that turmeric was associated with statistically significant decreases in body weight, triglyceride and LDL-c levels in patients suffering from hyperlipidemic type 2 diabetes mellitus [29]. In RCT on patients suffering from polycystic ovarian syndrome (PCOS) curcumin supplementation significantly increased gene expression of peroxisome proliferator activated receptor γ coactivator 1 α (PGC1α) and activity of the gluthathione peroxidase enzyme and non-significantly of sirtuin (SIRT)-1 gene and superoxide dismutase enzyme (30), therefore, anti-oxidative properties of turmeric may be of value in the treatment of PCOS.

CONCLUSION

Turmeric has been investigated as a potential anti-inflammatory, anti-oxidant, neuroprotective and cardiovascular-protective agent. These effects are mostly attributable to curcumin, which has poor pharmacokinetic profile (poor bioavailability) and therefore, should be used with piperine that increases its absorption significantly. Preclinical data showed that curcumin has potent anti-inflammatory properties comparable with celecoxib (COX-2 selective inhibitor) and naproxen (non-selective COX-1 and COX-2 inhibitor), it can inhibit the NF-κB activity, which may have significant implications in inflammatory diseases, and it also exerts anti-oxidant effects. Studies on animal models also showed that curcumin may have protective effects in mercury and TCDD poisoning. Both animal and human clinical studies have
showed that curcumin may exert neuroprotective, neurotropic, and anti-neuro-inflammatory properties, which may have implications in the alleviation of depression symptoms as well as the improvement of cognitive functions and prevention of stress-induced memory losses. It seems that combination of curcumin-piperine complex with saffron might exert synergistic neuroprotective effects and therefore, it could be beneficial for further investigation of this combined nutritional formula as a nutritional support in depression and (other) stress-induced psychological problems. Few clinical studies showed that curcumin may prevent endothelial dysfunction associated with oxidative stress, which was comparable to the treatment with atorvastatin in one study, and these effects may have important nutritional implications for the prevention of cardiovascular diseases. One study showed the potential of curcumin nutritional support in the prevention of myocardial infarction in patients undergoing CABG. Few clinical trials also showed clinical benefits of turmeric nutritional support alone or in combination with aerobic training (synergistic effect) on the lipid profile in patients suffering from hyperlipidemic type 2 diabetes mellitus, and therefore, such combined complementary therapeutic measures should be further studied in this group of patients. Curcumin supplementation may also be beneficial in PCOS, but more research is necessary.

REFERENCES


