CURCUMIN: BOON FOR HUMAN BEING

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ABSTRACT
Turmeric (Curcuma longa L.), commonly known spice, is well documented for its medicinal values in Indian systems of medicine. It has been broadly used cuisine as well as for the treatment of several disorders. Epidemiological observations, though indecisive, are suggestive that turmeric consumption may decrease the risk of some form of cancers and make other protective biological results in humans. These biological effects of turmeric have been featured to its active constituent curcumin that has been widely studied for its anti-inflammatory, anti-oxidant, anti-angiogenic, wound healing and anti-cancer effects. As a result of wide epidemiological, clinical, and animal studies several molecular mechanisms are emerging that elucidate multiple biological effects of curcumin. This review concludes the biological effects of curcumin.

KEYWORDS: Curcumin, Turmeric, Dietary supplement, Anti-cancer.

INTRODUCTION
Turmeric, or Curcuma longa L., is a spice native to India. Historically, turmeric has been used all over India, China and Indonesia as a spice and medicinal agent. Turmeric is a main spice that enhances the flavour of foods and is the base of most Indian curries. Turmeric is used in curries goes back more than 5000 years. People first used turmeric (curcuma) as a food ingredient which contains curcumin and later on discovered that it has impressive medicinal qualities. It is also identified as Haridra, Zirsood, Haldi, Halada, Manjal, Holdi, and Indian Saffron. Turmeric has been granted “Generally Recognized as Safe” (GRAS) status by the USFDA. Its anti-inflammatory properties have long been exploited in traditional oriental medicine. Men with benign hyperplasia of the prostate (BHP) are one
possible target group for prophylaxis, as are women who have a family history of breast cancer. The agent might also be precious as a supplement to firm cancer therapies. At all events, curcumin’s valuable effects must first be confirmed in controlled clinical tests. Research suggests that curcumin may be effective in fighting brain cancer\cite{3} renal cell carcinoma and Melanoma\cite{4} not merely in the scrap against cancer, but curcumin has also been found to have a positive effect on other health issues. Curcumin may assist avoid renal failure in diabetes\cite{5}, Wound healing, heart disease\cite{6}. Alzheimer’s.\cite{7,8} The list goes on to include anti-inflammatory\cite{9,10} and other amazing health effects. As noted turmeric comes as a powder, it is a spice that can be added to most foods. It is apparent that curcumin is a featured player in the war against cancer. Large body of research has promoted curcumin for anticancer properties. Curcuma is a potential chemo-preventive agent for treating certain cancers and other chronic inflammatory diseases.\cite{11} Effective in cases of colon cancer\cite{12}, pancreatic cancer\cite{13}, bone loss induced by breast cancer cell bone metastasis\cite{14} inhibit liver cancer growth\cite{15} inhibit leukemia\cite{16} novel and effective approach for the treatment of melanoma\cite{17} invaluable in assisting patients with Prostate Cancer.\cite{18} With chitosan (more popularly known weight loss aid) it is effective in combating certain lung cancers.\cite{19} When mixed with certain fatty acids, made a potent antioxidant, non-toxic, tumour inhibitor.\cite{20}

Description of plant

*Curcuma longa* L. is a perennial herb, and a member of the ginger family. It can grow up to 1 m high, and has oblong, tufted leaves. Needs temperatures between 20 °C and 30 °C (68 °F and 86 °F) and a considerable amount of annual rainfall to thrive.\cite{21} When not used fresh, the rhizomes are boiled for about 30–45 minutes and then dried in either in open or hot air ovens. After which they are grounded so that a deep orange-yellow powder.

<table>
<thead>
<tr>
<th>Part used</th>
<th>Description</th>
<th>Uses</th>
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<tbody>
<tr>
<td>Dried Whole Rhizome</td>
<td>Preparation: mother rhizomes (egg-shipped primary rhizomes) and finger rhizomes (cylindrical and Multi-branched secondary rhizomes) are usually boiled separately for about 40-60 min under slightly alkaline conditions in copper, galvanized iron or earth vessels and then sun-dried on bamboo mats for 10-15 days to reduce the moisture to 10-11%. Appearance: orange-brown, pale yellow or red-yellow Chemical Composition: may contain 3-15% cucuminoids and 1.5 to 5% essential oils</td>
<td>Medicine</td>
</tr>
</tbody>
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Table 1: Main products of turmeric (*Curcuma longa* L.)
<table>
<thead>
<tr>
<th>Ground Turmeric</th>
<th>Preparation: Powder is prepared from dried finger rhizomes (60-80 mesh). Appearance: yellow or red-yellow powder. Chemical Composition: Curcuminoids, it is appropriate to pack the powder in a UV protective container.</th>
<th>Spice: curry powder and pastes. dye: for food, textile, cosmetic Medicine: Ayurveda, Chinese Medicine, Dietary supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumeric Oils</td>
<td>Preparation: Extract from dried rhizomes (ground turmeric) or leaves by steam distillation or supercritical CO2 extraction Appearance: yellow to brown viscous liquid. Chemical Composition: essential oils from leaves are usually dominated by monoterpenes while the oil from rhizomes mainly contains sesquiterpenes.</td>
<td>Spice, medicine, and dietary Supplement</td>
</tr>
<tr>
<td>Tumeric Oleoresin</td>
<td>Preparation: Extract from dried rhizomes by solvent extraction with aceone, dichloromethane, 1,2-dichloroethane, methanol, ethanol, isopropanol and light petroleum (hexanes) or supercritical CO2 extraction. Graded by the content of curcuminoids or color value. Appearance: yellow-dark reddish brown oily fluids Chemical Composition: 37-55% curcuminoids and up to 25% essential oil.</td>
<td>Food colouring, medicine, and dietary Supplement</td>
</tr>
<tr>
<td>Curcumin (turmeric Yellow)</td>
<td>Preparation: obtained by solvent extraction from ground turmeric rhizomes and purification of the extract by crystallization. The suitable solvents include aceone, carbon dioxide, ethanol, ethyl acetate, hexane, methanol, isopropanol. Appearance: yellowish to orange red crystalline powder Chemical Composition: the product is often the mixture of curcumin and its demethoxy- and bisdemethoxy Derivatives in turmeric in varying proportions. The three major curcuminoids may account no less than 90%. Minor compounds may include oils and resins naturally occurring in turmeric rhizomes.</td>
<td>Medicine and dietary supplement</td>
</tr>
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</table>

**Phytochemistry of the Curcumin**

The active component in turmeric is *curcumin*, which may constitute 2 to 8 % of the spice. *Curcumin* is a non-water-soluble polyphenol that can be derived from *C. longa* L. by ethanol extraction, the first study on *curcumin* and its dose-limiting toxicity was not published until
2001, when it was reported that amounts of up to 8 g, administered per day for three months, were not toxic to humans.\cite{22} All curcuminoids are often referred to simply as “\textit{curcumin} [1, 7-bis (4-hydroxy-3-methoxyphenyl)-1, 6-heptadiene-3, 5-dione, Figure]” even though turmeric a variety of different curcuminoids.\cite{4} Commercial \textit{curcumin} typically contains three major curcuminoids: \textit{curcumin} (\textit{curcumin} I), demethoxycurcumin (\textit{curcumin} II) and bis-demethoxycurcumin (\textit{curcumin} III). Commercial \textit{curcumin} typically contains \textit{curcumin} I (~77%), \textit{curcumin} II (~17%) and \textit{curcumin} III (~3%) as its major components.\cite{23} The bioactive degradation products may contribute to the pharmacological effect of \textit{curcumin}.\cite{24}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{fig1.png}
\caption{Structure of \textit{curcumin}}
\end{figure}

\textbf{Ethno botanical usage}

In Ayurvedic system of medicine, numerous therapeutic activities have been assigned to turmeric for a wide variety of diseases and conditions, including those of the skin, pulmonary, gastrointestinal systems, aches, pains, wounds, sprains, and liver disorders. Extensive research within the last half century has proven that most of these pharmacological activities associated with turmeric are due to active ingredient \textit{curcumin}.\cite{25} Ethno-botanically \textit{curcumin} has been proven as a potent compound which act as an antioxidant, anti-inflammatory and anticancer in both man and animals.\cite{22} It has been reported that these effects are mediated through the regulation of various transcription factors, growth factors, inflammatory cytokines, protein kinases, and other enzymes.\cite{1} The ability of \textit{curcumin} to cross the blood brain barrier (BBB) may afford protection against neurodegenerative disorders.\cite{26,27}

\textbf{Pharmacokinetics.}

Pharmacokinetic studies in animals have demonstrated that 40-85 percent of an oral dose of \textit{curcumin} passes through the gastrointestinal tract unchanged, with most of the absorbed
flavonoid being metabolized in the intestinal mucosa and liver. Due to its low rate of absorption, *curcumin* is often formulated with bromelain for increased absorption and enhanced anti-inflammatory effect.[28]

Clinical aspect.

**Concept of formulations**

*Curcumin* can be administered single or in combination of other herbal drugs in various formulations. Formulations are prepared to make the drug available in all seasons and regions with the ease of palatability.

<table>
<thead>
<tr>
<th><strong>External use:</strong></th>
<th><strong>Internal use:</strong></th>
<th><strong>Topical gel formulation</strong></th>
<th><strong>Curcumin formulated</strong></th>
</tr>
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<tbody>
<tr>
<td>Turmeric +Lime +Honey, Turmeric +Onion past +Chandan all for moister and glowing the face</td>
<td>Digestive disorder, Liver Diseases, Atherosclerosis, Osteo-sclorosis, Menstrual problems of woman, Bacterial Wounds, Dementia, Eye Disorders</td>
<td>Lapacol, Carbapolo - antinflammetry Serratopeptidase- Non steroidal anti-inflammatory</td>
<td>with phosphatidylcholine - furnishes higher systemic levels of parent agent than unformulated curcumin.</td>
</tr>
<tr>
<td>Paste of <em>curcumin</em> for leprosy &amp; skin disease</td>
<td>Other health disorders- Colitis, Crohn’s disease, diarrhea, post-giardiaor post salmonella conditions. <em>Curcumin</em> is effectual for purification the chakrs, as well as purifying the path of the subtle body.</td>
<td>Nano Formulation: Curcumin Emulsomes- nano formulation for enhanced solubility and delivery of <em>curcumin</em> Rubusoside <em>curcumin</em> - inhanse solubility of <em>curcumin</em> and work as anticancer activity</td>
<td>Self- micro emulsifying systems in liquid and pellet forms are promising strategies for the formulation of poorly soluble lipophilic compounds with low oral bioavailability.</td>
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<td>Powder/pest of curcumin for small pox and chicken pox turmeric pest</td>
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<td>Treatment of dandruff, Hair coloration dye</td>
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Table 2: Mechanism of action of Curcumin against different activities.

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<tr>
<th>S.NO</th>
<th>Activity</th>
<th>Mechanism of action</th>
<th>References</th>
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<tbody>
<tr>
<td>1.</td>
<td>Antioxidant Effects</td>
<td><em>Curcumin</em> exhibit strong antioxidant activity, comparable to vitamins C and E. A study of ischemia in the feline heart demonstrated that curcumin pretreatment decreased ischemia-induced changes in the heart. An in vitro study measuring the effect of curcumin on endothelial heme oxygenase-1, an inducible stress protein, Curcumin resulted in enhanced cellular resistance to oxidative damage.</td>
<td>[29]</td>
</tr>
<tr>
<td>2.</td>
<td>Hepatoprotective Effects</td>
<td><em>Curcumin</em> has been found to have a hepatoprotective characteristic similar to silymarin. Turmeric’s hepatoprotective effect is mainly a result of its antioxidant properties, as well as its ability to decrease the formation of pro-inflammatory cytokines. Curcumin extract inhibited fungal aflatoxin production by 90 percent when given to ducklings infected with Aspergillus parasiticus. Curcumin also reversed biliary hyperplasia, fatty changes, and necrosis induced by aflatoxin production.</td>
<td>[30]</td>
</tr>
<tr>
<td>3.</td>
<td>Anti-inflammatory Effects</td>
<td>The volatile oils and <em>curcumin</em> exhibit potent anti-inflammatory effects. <em>Curcumin</em> may be applied topically to counteract inflammation and irritation associated with inflammatory skin conditions and allergies, although care must be used to prevent staining of clothing from the yellow pigment.</td>
<td>[29] [31]</td>
</tr>
<tr>
<td>4.</td>
<td>Antimicrobial Effects</td>
<td><em>Curcumin</em> inhibit the growth of a variety of bacteria, parasites, and pathogenic fungi. <em>Curcumin</em> have moderate activity against Plasmodium falciparum and Leishmania major organisms.</td>
<td>[32]</td>
</tr>
<tr>
<td>5.</td>
<td>Cardiovascular Effects</td>
<td><em>Curcumin</em> have protective effects on the cardiovascular system include lowering cholesterol and triglyceride levels, decreasing susceptibility of low density lipoprotein (LDL) to lipid peroxidation and inhibiting platelet aggregation. <em>Curcumin</em> effects on cholesterol levels may be due to decreased cholesterol uptake in the intestines and increased conversion of cholesterol to bile acids in the liver. Inhibition of platelet aggregation by <em>Curcumin</em> is thought to be via potentiation of prostacyclin synthesis and inhibition of thromboxane synthesis</td>
<td>[33]</td>
</tr>
<tr>
<td>6.</td>
<td>Anti diabetic activity</td>
<td>Previous animal studies have shown that <em>Curcumin</em> lowers plasma glucose. <em>Curcumin</em> may thus be a promising ingredient in functional foods aimed at preventing type 2 diabetes. The purpose of the study is to study the effect of <em>Curcumin</em> on postprandial plasma glucose, insulin levels and glycemic index (GI) in healthy subjects. The ingestion of 6 g C. longa increased postprandial serum insulin levels, but did not seem to affect plasma glucose.</td>
<td>[34]</td>
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levels or GI, in healthy subjects. The results indicate that C. longa may have an effect on insulin secretion.

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<td>7.</td>
<td><strong>Gastrointestinal Effects</strong></td>
<td><em>Curcumin</em> exert several protective effects on the gastrointestinal tract. Sodium curcuminate inhibited intestinal spasm and p-tolymethylcarbinol, a turmeric component.increased gastrin, secretin, bicarbonate, and pancreatic enzyme secretion Turmeric has also been shown to inhibit ulcer formation caused by stress, alcohol, indomethacin, pyloric ligation, and reserpine, significantly increasing gastric wall mucus in rats subjected to these gastrointestinal insults .</td>
</tr>
<tr>
<td>8.</td>
<td><em>Curcumin</em> enhances immunity</td>
<td><em>Curcumin</em> can help the body fight off cancer should some cells escape apoptosis. When researchers looked at the lining of the intestine after ingestion of <em>curcumin</em>, they found that CD4+ T helper and B type immune cells were greater in number. In addition to this localized immune stimulation</td>
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<tr>
<td>9.</td>
<td><em>Curcumin</em> blocks NF-κB</td>
<td>It has been investigated that H. pylori-induced NF-κB activation and the subsequent release of interleukin 8 (IL-8) are inhibited by <em>curcumin</em> (diferuloylmethane), a yellow pigment in turmeric (<em>Curcuma</em>).</td>
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<tr>
<td>10.</td>
<td>Pregnancy and Lactation</td>
<td>Although there is no evidence that dietary consumption of turmeric as a spice adversely affects pregnancy or lactation, the safety of <em>curcumin</em> supplements in pregnancy and lactation has not been established.</td>
</tr>
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<td>11.</td>
<td>Neuroprotective effect</td>
<td><em>Curcumin</em> significantly diminished infarct volume, improved neurological deficit, decreased mortality, reduced the water content of the brain</td>
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<tr>
<td>12.</td>
<td>Antihyperlipidemic effect</td>
<td><em>Curcumin</em> reduce lipid profiles such as serum total cholesterol, triglyceride and LDLcholesterol and VLDL-cholesterol</td>
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**Nano Curcumin**

Nanocurcumin has improved anticancer effects as compared to normal *curcumin* formulations. Among nanoformulations, few composite nanosystems have the simultaneous properties of therapeutic activity and multifunctional of nanocurcumin delivery platforms by enhancing a steady aqueous dispersion state. nanoparticles as enhanced image contrast agents.

(a) **Anti Cancer** - Thus to address the challenges to the development of further studies are needed using preclinical and clinical models to recommend nanocurcumin as a drug of choice for cancer therapy.\(^{[43]}\)

(b) **Anti Dementia**- The clinically studied chemical properties of nanocurcumin and its various effects on dementia shows the possibility to do further research and develop better
drugs based on *curcumin* for treating dementia. The recent review paper of John Ringman also supports some of the abovementioned properties of *curcumin* in dementia; however, large-scale human studies are required to identify the prophylactic and therapeutic effect of *curcumin*.\(^{[44]}\)

**REFERENCE**


40. Hanif, R., et al., Curcumin, a natural plant phenolic food additive, inhibits cell proliferation and induces cell cycle changes in colon adenocarcinoma cell lines by a prostaglandin-independent pathway. Journal of Laboratory and Clinical Medicine, 1997; 130(6): 576-584.


