Curcumin and Colorectal Cancer: Add Spice to Your Life

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Abstract

It is a mystery why colon cancer incidence in the United States is among the highest (530 cases per million) when compared with other countries, such as India (30 cases per million). However, it has been proposed that lifestyle may account for 90% to 95% of all cancers. Curcumin, derived from the spice turmeric (curry powder), is a major component of Indian lifestyle. This agent has been shown to suppress survival, proliferation, invasion, angiogenesis, and metastasis of colon cancer cells through the regulation of various cell signalling pathways and biomarkers, such as nuclear factor-κB, peroxisome proliferator–activated receptor-γ, early growth response-1, β-catenin, mitogen-activated protein kinases, cyclin D1, epidermal growth factor receptor, N-acetyltransferase, cyclooxygenase-2, 5-lipoxygenase, GADD153, p53, B-cell lymphoma 2, basal cell lymphoma–extra large, and ceramide. Animal studies showed that curcumin can protect against various carcinogens mediating colon cancer. Curcumin can also sensitize tumours to chemotherapy and radiation.

Clinical trials suggest that curcumin has activity against familial adenomatous polyposis, inflammatory bowel disease, irritable bowel syndrome, and colon cancer. This review discusses the preventive and therapeutic potential of curcumin against colorectal cancer and thus provides 'reasoning for seasoning'.

Introduction

Like most Western countries, the United States has a high incidence of colorectal cancer (CRC) (530 cases per million), whereas Eastern countries (eg, India) have some of the lowest. The reason behind this difference is not fully understood [(1)]; however, numerous studies indicate that lifestyle-related factors contribute as much as 95% to the incidence of cancers [(2)]. What is so unique about the Indian lifestyle is uncertain, but vegetarianism and certain spices unique to the India population may contribute to the lower colon cancer incidence. The history of spices dates back to Vasco de Gama (1498), a Portuguese sailor who discovered India while searching for spices. One of the spices he found was turmeric (curry powder), which was an essential part of Indian lifestyle and was used for cooking. This spice has been described in Ayurveda (a system of medicine native to India) as a treatment for most proinflammatory diseases and for bacterial, viral, and fungal infections [(3)]. Extensive research during the past 50 years revealed that curcumin is the active component of turmeric.

Chemistry of Curcumin

Turmeric - also referred to as Indian saffron, yellow ginger, yellow root, kacha haldi, ukon, or natural yellow 3 - contains 3% to 5% curcumin (diferuloylmethane). This polyphenol was first isolated in 1815 and was obtained in crystalline form in 1870. The structure of curcumin as 1,6-heptadiene-3,5-dione-1,7-bis (4-hydroxy-3-methoxyphenyl)-(1E,6E) was confirmed in 1910 by Lampe. In addition to curcumin, turmeric contains demethoxycurcumin and bisdemethoxycurcumin. Cyclocurcumin is another novel analogue recently identified in turmeric. Commercially available curcumin contains approximately 77% curcumin, 17% demethoxycurcumin, and 3% bisdemethoxycurcumin. Although curcumin was found to be the most potent of the three [(4,5)], bisdemethoxycurcumin exhibited higher activity in certain systems [(4)]. Some data suggest the mixture of all three is more potent than one alone [(5)].Various phytochemicals derived from turmeric exhibit strong structural homology to those derived from ginger (gingerol), guinea pepper (paradol), Zingiber cassumunar (cassumuin A and B), alpinia (yakuchinone-A), red chili (capsaicin), glycyrrhiza (dibenzoylmethane), and clove (iso-eugenol).

Effect of Curcumin on Molecular Targets in Colon Cancer

Accumulating evidence suggests that curcumin has a diverse range of molecular targets, supporting the concept that it acts upon numerous biochemical and molecular cascades. This polyphenol modulates various targets through direct interaction or modulation of gene expression. Curcumin physically binds to as many as 33 different proteins [(6)], including thioredoxin