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Medicinal activity of curcuma longa in treatment of cancer.

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Description

Cancer is the second most life-threatening disease and one of the biggest public health problems in the world. In 2018, there were approximately 1.73 million new cancers and 609,000 deaths in the United States alone. Despite the tangible progress in cancer treatment, the morbidity and mortality of the disease have not decreased in the past 30 years. Understanding the molecular changes that contribute to the development and progression of cancer can be a key insight into the prevention and treatment of cancer. There are several common strategies that can target specific cancer cells to inhibit tumour development, progression and metastasis without causing serious side effects. In addition to chemically synthesized anticancer agents, several anticancer compounds with different modes of action have been extracted from plant sources, such as Pacific yew, *Catharanthus roseus, Betula platyphylla, Cephalotaxus chinensis, Taxus chinensis*, turmeric, etc.

Among them, curcumin is the most important component in the turmeric rhizome. It was first extracted from the turmeric plant in pure crystal form in 1870. Curcumin and its derivatives have received a great deal of attention in the last 20 years due to their biological functions such as anti-tumour, anti-oxidant and anti-inflammatory activities. These properties are attributed to key elements in the structure of curcumin. Therefore, many scientific articles have clarified the Structure-Activity Relationship (SAR) of curcumin to enhance its physical, chemical and biological properties. Due to the importance of cancer as the main explanation for death, more effective and less toxic anticancer agents are being sought. The main mechanism for curcumin to exert its unique anti-cancer activity includes inducing cell apoptosis and inhibiting tumour proliferation and invasion by inhibiting the selection of cell signaling pathways. Several studies have reported the antitumor activity of curcumin against cancer, carcinoma, head and neck epithelial cell carcinoma, prostate adenocarcinoma, and brain tumors, indicating that it may target a variety of cancer cell lines. Despite all the above advantages, the application of curcumin is limited due to its low solubility in water, which ultimately leads to poor oral bioavailability and low chemical stability. Another obstacle is the low cellular absorption of curcumin. Due to their hydrophobicity, curcumin molecules tend to penetrate cell membranes and combine with the fatty acyl chains of membrane lipids through hydrogen bonding and hydrophobic interactions, resulting in low utilization of curcumin in cells. In order to overcome these obstacles and improve the overall anti-cancer activity of curcumin, some structural modifications are recommended to increase the selective toxicity of specific cancer cells, increase bioavailability or increase stability. Another method is to use different delivery systems to improve the physicochemical properties and anti-cancer activity of curcumin.

Curcumin is the active ingredient in turmeric extract and has been extensively studied in recent decades for its anti-inflammatory, antioxidant, anti-cancer, and anti-androgen effects. Curcumin has shown considerable anticancer effects against several different types of cancer *in vitro* and *in vivo*, including prostate cancer, breast cancer, colorectal cancer, pancreatic cancer, and head and neck cancer. Additionally, their efficacy and safety in cancer patients, whether used alone or in combination with other anticancer drugs, have been confirmed in several human clinical studies. Curcumin is believed to exert its anticancer activity through multiple mechanisms, interfere with different cellular pathways, and induce/inhibit the production of various cytokines, enzymes, or growth factors, such as MAPK, EGF, NFκB, PKD1, COX2, STAT3, TNFα and IκKβ. However, the anticancer application of curcumin is limited, mainly due to its low solubility in water, resulting in low cellular absorption, poor oral bioavailability, and low chemical stability. To overcome these limitations, different methods have been adopted, such as structural modification and the use of drug delivery systems.

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