Turmeric and Cancer Prevention: Unveiling the Potential of Nature's Golden Spice

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Abstract: Turmeric is the rhizome of the Curcuma longa Linn plant. Turmeric contains anti-inflammatory, antioxidant, and anti-cancer effects. Curcumin, turmeric's main bioactive component, is responsible for its anti-cancer benefits. Curcumin is a polyphenolic molecule produced from turmeric, a famous Indian spice. This not only improves their efficacy, but it may also mitigate the negative effects associated with higher doses. Turmeric's anti-angiogenic effects, particularly its reduction of vascular endothelial growth factor (VEGF), aid in the prevention of new blood vessel creation that feeds tumours. When combined with normal medicines, turmeric may help starve tumours, making them more vulnerable to the effects of chemotherapy and radiation therapy. Turmeric has been found in clinical and preclinical trials to improve treatment outcomes. Turmeric's distinct properties contribute to a more holistic and synergistic approach to cancer treatment, whether utilized in conjunction with chemotherapy, radiation therapy, or other standard treatments.

Keywords: Turmeric, Cancer Prevention, Curcumin, Antioxidants, Anti-angiogenic

1. Introduction

Turmeric is a rhizome of plant Curcuma longa Linn, frequently mentioned in ancient Ayurvedic and traditional Chinese medical writings as effective for prevention and treatment of a number of human illnesses. Dried turmeric powder is also used in Indian culinary and is the key component in all "curry" recipes. Turmeric powder has a yellow and contains a variety of curcuminoids, including curcumin (77%), desmethoxycurcumin (17%), and bisdemethoxycurcumin (3%). Curcumin is classified as a polyphenol (1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione). Curcumin is recognized as a potent medication in Ayurvedic medicine for a variety of ailments including anorexia, asthma, cough, sinusitis, allergy, coryza, bronchial hyperactivity and hepatic disease. Cancer, a complex and multifaceted group of diseases, continues to be a major global health concern. As researchers delve deeper into understanding its causes and potential preventive measures, natural compounds found in various plants are gaining attention

for their promising anti-cancer properties. One such potent spice that has been at the forefront of this research is turmeric, widely recognized for its vibrant yellow hue and therapeutic properties.

2. The Active Ingredient Curcumin

Curcumin is a type of polyphenolic compound derived from the popular Indian spice turmeric plant. It is a member of the Zingiberaceae (ginger) family, which is found in Southeast Asia. The primary bioactive component in turmeric, curcumin, is responsible for its anti-cancer properties. Curcumin is a polyphenolic a compound that has anti-inflammatory, antioxidant, and cancer-fighting effects. Numerous research has been conducted to investigate its ability to suppress the proliferation of cancer cells, prevent tumour spread, and perhaps improve the efficacy of established cancer therapies. As Curcumin is lipophilic in nature it shows a low solubility and stability in aqueous solution. Curcumin, due to its unique features such as antiprotozoal and antioxidant capabilities, may have a major influence on the prevention of numerous illnesses. Curcumin has been the subject of extensive research for decades, with around 6850 papers providing deeper insight into its pharmacological and health effects. Many studies have found it to be anti-oxidant, anti-arthritic, anti-inflammatory, hepatoprotective, cardioprotective, thrombosuppressive, anti-infectious, chemo preventive, and anti-carcinogenic.

3. Anti Inflammatory Properties:

Chronic inflammation has been linked to the further development and increasing of cancer. Turmeric, especially curcumin, has been shown to have powerful anti-inflammatory properties. Curcumin may help establish an environment less favourable to the genesis and proliferation of cancer cells by lowering inflammation at the cellular level. Curcumin has been found to be effective in the prevention and treatment of a variety of inflammatory diseases. Several lines of evidence point to cyclooxygenase and lipoxygenase-catalysed arachidonic and linoleic acid metabolism playing a role in cancer formation. Biosynthetic routes for arachidonic acid-derived lipid mediators implicated in inflammation rely on cyclooxygenase (COX) and lipoxygenase (LOX) enzymes. Curcumin's anti-inflammatory impact is most likely achieved by its capacity to inhibit cyclooxygenase-2 (COX-2), lipoxygenase (LOX), and inducible nitric oxide synthase (iNOS), all of which are essential enzymes involved in inflammatory processes.

4. Antioxidant Defence:

Turmeric's antioxidant capabilities are critical in cancer prevention. Free radicals,

which are unstable chemicals that can damage cells and DNA, have a role in cancer formation. Curcumin is a potent antioxidant that neutralizes free radicals and protects cells from oxidative stress. This antioxidative defence is thought to contribute to a decrease in cancer risk overall. Curcumin, the bioactive component responsible for many of turmeric's health advantages, is at the vanguard of its antioxidant defence. Curcumin has potent antioxidant qualities that allow it to scavenge free radicals and neutralize their harmful effects. Curcumin, according to research, not only neutralizes existing free radicals but also boosts the body's own antioxidant enzymes, resulting in a strong internal defence against oxidative stress.

5. Inhibition of Cancer Cell Growth:

Numerous research has been conducted to investigate the relationship between oxidative stress and cancer development. Turmeric's antioxidants play an important function in avoiding genetic abnormalities and cellular changes that can lead to the production of malignant cells by countering oxidative damage. Curcumin's capacity to influence different signalling pathways involved in cell proliferation, inflammation, and death adds to its overall anti-cancer actions, with most of this assigned to its antioxidant properties. Turmeric, especially curcumin, disrupts critical signalling pathways that control cell growth and division. Turmeric inhibits the excessive multiplication of cancer cells, which is a hallmark of carcinogenesis, by interrupting several mechanisms. Turmeric's capacity to cause apoptosis, a planned cell death essential for maintaining cellular equilibrium, is one of its most significant contributions to cancer prevention. Curcumin activates apoptotic pathways in cancer cells, causing them to die in a regulated manner. Turmeric inhibits cancer cell progression at various stages by modulating the cell cycle. This interference in the cell cycle machinery prevents uncontrolled cell division and helps to reduce cancer cell proliferation overall.

6. Anti-Angiogenic Effects:

Angiogenesis is the creation of new blood vessels from already existing ones. While this is a normal and necessary process for the growth and development, it also plays an important part in cancer progression. Tumours initiate angiogenesis in order to sustain rapid growth by forming a network of blood vessels that provide them with oxygen and nutrients. Inhibiting this mechanism has emerged as a possible cancer prevention strategy. Various angiogenic factors, such as basic fibroblast growth factor (bFGF), vascular endothelial

growth factor (VEGF), angiogenin, transforming growth factors (TGF-α, TGF-β), and epidermal growth factor, orchestrate this intricate dance, releasing molecules and signalling neighbouring normal host tissues. VEGF, a crucial survival factor for endothelial cells, is particularly noteworthy in tumour angiogenesis. It influences the expression of antiapoptotic proteins in the endothelial cells, promoting their survival. Notably, drugs like Bevacizumab (Avastin) have been developed as inhibitors of VEGF action in cancer treatment. However, the cost of such medications often renders them inaccessible to a significant portion of the population, necessitating the exploration of safe and affordable alternatives to control cancer development. Curcumin, the bioactive compound found in turmeric, has emerged as a promising natural inhibitor of VEGF in including orthotopically implanted pancreatic tumours, various types of cancer. In both in vitro and in vivo studies, curcumin has demonstrated its ability to suppress the proliferation of human vascular endothelial cells and counteract the angiogenic response induced by fibroblast growth factor-2 (FGF-2).

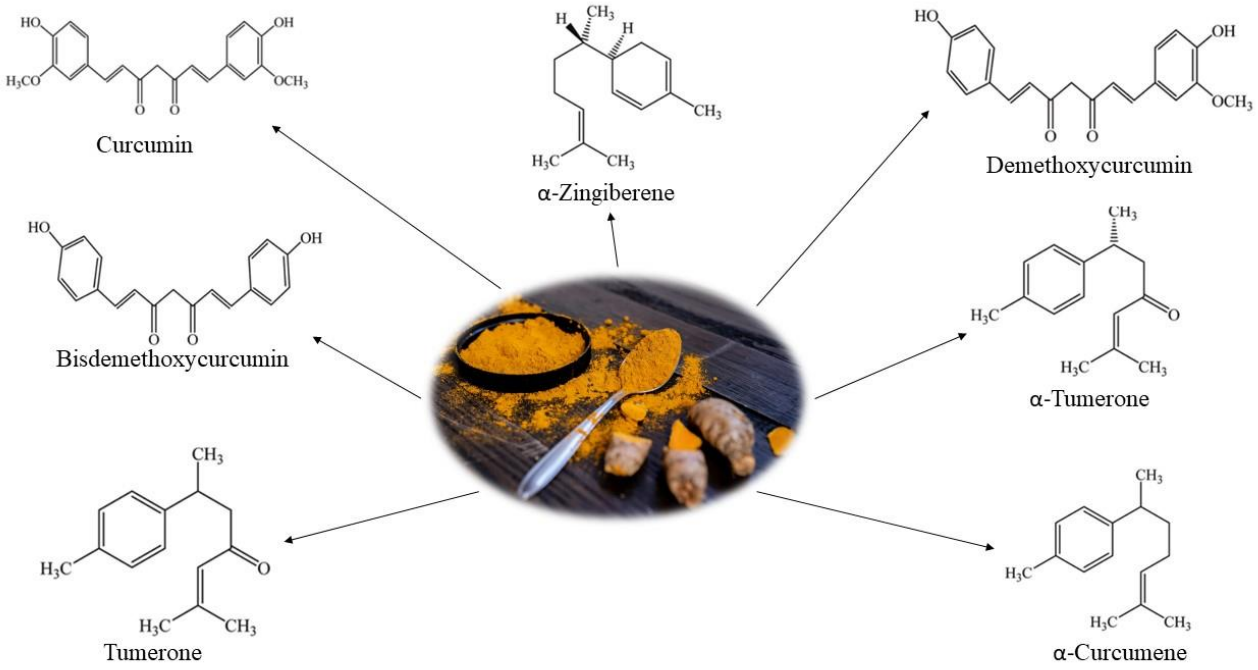

Fig. Major chemical constituents of turmeric.

7. Enhancing Traditional Cancer Treatments:

Traditional cancer therapies, such as chemotherapy and radiation therapy, have proven critical in the cancer fight. However,

these approaches frequently have unintended consequences and difficulties. Turmeric, with its major component curcumin, has emerged as a promising complement to standard cancer therapies in recent years, as the attention has shifted to natural substances. This study investigates how turmeric improves the efficacy of conventional medicines, providing a supplementary approach to cancer treatment. Turmeric, namely the bioactive ingredient curcumin, has shown to sensitize cancer cells to the effects of conventional therapy. According to research, curcumin can increase cancer cell sensitivity to chemotherapy and radiation therapy, perhaps allowing for lower dosages of these therapies. This not only increases their efficacy, but it may also reduce the negative effects associated with greater dosages. Turmeric's anti-angiogenic properties, notably its suppression of vascular endothelial growth factor (VEGF), help to prevent the formation of new blood vessels that feed tumours. Turmeric may help starve tumours, making them more sensitive to the effects of chemotherapy and radiation therapy when paired with standard therapies. Turmeric has been shown in clinical studies and preclinical research to improve treatment results. Turmeric's unique qualities contribute to a more holistic and synergistic approach to cancer care whether used with chemotherapy, radiation therapy, or other traditional therapies.

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