Title

Thymol as adjuvant in oncology: molecular mechanisms, therapeutic potentials, and prospects for integration in cancer management

Abstract

Cancer remains a global health challenge, prompting a search for effective treatments with fewer side effects. Thymol, a natural monoterpenoid phenol derived primarily from thyme (Thymus vulgaris) and other plants in the Lamiaceae family, is known for its diverse biological activities. It emerges as a promising candidate in cancer prevention and therapy. This study aims to consolidate current research on thymol's anticancer effects, elucidating its mechanisms and potential to enhance standard chemotherapy, and to identify gaps for future research. A comprehensive review was conducted using databases like PubMed/MedLine, Google Scholar, and ScienceDirect, focusing on studies from the last 6 years. All cancer types were included, assessing thymol's impact in both cell-based (in vitro) and animal (in vivo) studies. Thymol has been shown to induce programmed cell death (apoptosis), halt the cell division cycle (cell cycle arrest), and inhibit cancer spread (metastasis) through modulation of critical signaling pathways, including phosphoinositide 3-kinase (PI3K), protein kinase B (AKT), extracellular signal-regulated kinase (ERK), mechanistic target of rapamycin (mTOR), and Wnt/β-catenin. It also enhances the efficacy of 5-fluorouracil (5-FU) in colorectal cancer treatments. Thymol's broad-spectrum anticancer activities and non-toxic profile to normal cells underscore its potential as an adjunct in cancer therapy. Further clinical trials are essential to fully understand its therapeutic benefits and integration into existing treatment protocols.

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