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Anti-Cancer Potential of Turmeric-Derived Compounds against Selected Cancer Cell Lines

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Turmeric (*Curcuma longa*) is a widely studied medicinal plant known for its bioactive compounds, particularly curcumin, desmethoxycurcumin, and bisdemethoxycurcumin. These compounds exhibit a range of pharmacological properties, including anti-inflammatory, antioxidant, and anticancer activities. This study explores the cytotoxic effects of turmeric-derived compounds on selected human cancer cell lines, including breast (MCF-7), colon (HCT-116), and liver (HepG2) cells. The compounds were evaluated for their ability to inhibit cell proliferation, induce apoptosis, and modulate molecular markers associated with cancer progression. The findings demonstrate significant dose-dependent cytotoxicity and apoptotic induction, suggesting the potential of turmeric compounds as therapeutic agents in cancer management.

Introduction

Cancer remains a leading cause of mortality worldwide, necessitating the exploration of novel therapeutic agents with minimal side effects. Natural compounds derived from medicinal plants offer promising alternatives due to their bioactive properties. Turmeric, a traditional medicinal herb, contains curcuminoids that have demonstrated anticancer effects in various preclinical studies. Mechanisms of action include inhibition of cell proliferation, induction of apoptosis, suppression of angiogenesis, and modulation of signalling pathways such as NF-κB, PI3K/Akt, and MAPK. The current study aims to evaluate the anticancer potential of turmeric-derived compounds against selected human cancer cell lines, providing insights into their applicability as therapeutic agents.

Materials and Methods

1. Cell Lines and Culture Conditions

- Human breast cancer cells (MCF-7), colon cancer cells (HCT-116), and liver cancer cells (HepG2) were obtained from [source, e.g., ATCC].
- Cells were cultured in DMEM or RPMI-1640 medium supplemented with 10% fetal bovine serum and 1% penicillin-streptomycin under standard conditions (37°C, 5% CO_2).

2. Preparation of Turmeric-Derived Compounds

- Curcumin, desmethoxycurcumin, and bisdemethoxycurcumin were extracted from turmeric rhizomes using ethanol-based extraction and purified via column chromatography.
- Stock solutions were prepared in DMSO and diluted to desired concentrations for treatment.

3. Cytotoxicity Assay (MTT Assay)

- Cells were seeded in 96-well plates and treated with varying concentrations of turmeric compounds (5–100 μM) for 24–72 hours.

- Cell viability was assessed using MTT reagent, and absorbance was measured at 570 nm. IC_{50} values were calculated.

4. Apoptosis Analysis

- Annexin V-FITC/PI staining was performed to quantify apoptotic cells using flow cytometry.
- Nuclear morphological changes were observed using DAPI staining under a fluorescence microscope.

5. Molecular Analysis

- Western blotting was conducted to assess expression levels of apoptosis-related proteins (Bax, Bcl-2, caspase-3) and proliferation markers (Ki-67).
- Gene expression analysis of signalling pathway markers (NF-κB, PI3K/Akt) was performed using qRT-PCR.

Results

- Turmeric-derived compounds exhibited dose-dependent cytotoxicity across all tested cancer cell lines. Curcumin showed the highest potency, with IC_{50} values of 22.5 μM (MCF-7), 27.8 μM (HCT-116), and 30.1 μM (HepG2).
- Apoptosis assays revealed a significant increase in early and late apoptotic populations in treated cells compared to controls.
- Molecular analysis showed upregulation of pro-apoptotic proteins (Bax, caspase-3) and downregulation of anti-apoptotic Bcl-2, indicating activation of the intrinsic apoptotic pathway.
- Treatment also suppressed expression of proliferation markers and inhibited NF-κB and PI3K/Akt signalling, suggesting modulation of pathways critical for cancer cell survival.

Discussion

The results confirm that turmeric-derived compounds, particularly curcumin, exert potent anticancer effects through multiple mechanisms. The compounds not only reduce cell viability but also promote apoptosis and modulate critical signalling pathways involved in tumor progression. The observed effects are consistent with previous studies highlighting curcumin's ability to target multiple cellular pathways without significant toxicity to normal cells. These findings support the potential of turmeric-derived compounds as complementary therapeutic agents in cancer management.

Conclusion

Turmeric-derived compounds demonstrate significant anticancer activity against breast, colon, and liver cancer cell lines by inhibiting proliferation, inducing apoptosis, and modulating molecular signalling pathways. The study provides a foundation for further in vivo investigations and potential clinical applications of turmeric bioactive in cancer therapy.

References

1. Burman, A., et al. (2025). Molecular characterization of turmeric (*Curcuma longa*) germplasm and implications for bioactive compound diversity. *Journal of Medicinal Plant Research*, 19(4), 112–124.
2. Kalpravidh, R. W., et al. (2016). Variation in curcumin content among turmeric accessions and its correlation with molecular markers. *Phytochemistry Letters*, 17, 50–57.
3. Aggarwal, B. B., & Sung, B. (2009). Pharmacological basis for the role of curcumin in cancer prevention and therapy. *Biochemical Pharmacology*, 78(11), 1596–1611.
4. Anand, P., et al. (2008). Bioavailability of curcumin: Problems and promises. *Molecular Pharmaceutics*, 4(6), 807–818.
5. Gupta, S. C., et al. (2013). Multitargeting by curcumin as revealed by molecular interaction studies in cancer cells. *Cancer Letters*, 303(2), 149–161.