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FROM KITCHEN TO CLINIC: THE THERAPEUTIC PROMISE OF SPICES IN ONCOLOGY

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Abstract

Spices have long been revered in traditional medicine for their therapeutic properties. Recent scientific investigations are uncovering their potential roles in cancer prevention and adjunctive treatment. Exploring six widely used spices-turmeric, ginger, garlic, cinnamon, black pepper and others highlighting their bioactive compounds, mechanisms of action and current evidence from laboratory and clinical studies. While not substitutes for conventional cancer therapies, these spices offer promising avenues for integrative oncology.

Introduction

Cancer remains one of the leading causes of mortality worldwide. While conventional treatments such as chemotherapy, radiation and surgery are essential, there is growing interest in complementary approaches that harness natural compounds. Spices, rich in polyphenols and bioactive molecules, have emerged as potential allies in the fight against cancer. Focusing on six spices commonly found in kitchens and increasingly studied in laboratories: turmeric, ginger, garlic, cinnamon, black pepper and others.

Turmeric (*Curcuma longa*)

Key Compound: Curcumin

Curcumin is a polyphenol responsible for turmeric's vibrant yellow color and its potent biological activity.

Mechanisms of Action

- **Anti-inflammatory**: Inhibits NF-κB and COX-2 pathways.
- **Antioxidant**: Scavenges free radicals and enhances antioxidant enzymes.
- **Apoptosis and Cell cycle arrest**: Induces programmed cell death and halts proliferation.
- **Anti-angiogenic**: Prevents the formation of new blood vessels that feed tumours.

Evidence

- *In vitro* studies show curcumin inhibits growth of breast, colon, prostate and pancreatic cancer cells.
- Clinical trials suggest curcumin may reduce precancerous lesions in colorectal cancer.
- Bioavailability remains a challenge, often addressed by combining curcumin with piperine (from black pepper).

Ginger (*Zingiber officinale*)

Key Compounds: Gingerols and Shogaols

These phenolic compounds are responsible for ginger's

pungency and pharmacological effects.

Mechanisms of Action

- **Apoptosis Induction**: Promotes the death of cancer cells.
- **Anti-inflammatory**: Suppresses pro-inflammatory cytokines and enzymes.
- **Antioxidant**: Protects DNA from oxidative damage.

Evidence

- Ginger extracts inhibit the proliferation of colorectal, ovarian and pancreatic cancer cells.
- Animal studies show reduced tumour size and improved survival rates.
- Human trials are limited but suggest potential in nausea management during chemotherapy.

Garlic (*Allium sativum*)

Key Compound: Allicin

Allicin and its derivatives (diallyl sulfide, diallyl disulfide) are formed when garlic is crushed.

Mechanisms of Action

- **Detoxification**: Enhances liver enzymes that neutralize carcinogens.
- **Immune Modulation**: Boosts natural killer cells and macrophage activity.
- **DNA Repair and Apoptosis**: Promotes cellular repair and programmed death in cancer cells.

Evidence

- Epidemiological studies link garlic consumption to reduced risk of stomach and colorectal cancers.
- Laboratory studies confirm garlic's ability to inhibit tumour growth and metastasis.

Cinnamon (*Cinnamomum verum*)

Key Compound: Cinnamaldehyde

Cinnamaldehyde is responsible for cinnamon's aroma and its anticancer properties.

Mechanisms of Action

- **Anti-proliferative**: Disrupts cell cycle and inhibits tumour growth.
- **Anti-angiogenic**: Reduces blood vessel formation in tumours.
- **Oxidative Stress Reduction**: Neutralizes free radicals.

Evidence

- *In vitro* studies show cinnamon extracts reduce the growth of cervical and colorectal cancer cells.
- Animal models demonstrate tumour suppression and reduced inflammation.

Black Pepper (*Piper nigrum*)

Key Compound: Piperine

Piperine enhances the bioavailability of other compounds and has direct anticancer effects.

Mechanisms of Action

- **Synergistic Effects**: Boosts absorption of curcumin and other phytochemicals.
- **Anti-metastatic**: Inhibits migration and invasion of cancer cells.
- **Angiogenesis Inhibition**: Prevents tumour vascularization.

Evidence

- Piperine suppresses the growth of breast and prostate cancer cells.
- Combined with curcumin, it significantly enhances anticancer efficacy.

Limitations and Challenges

Despite promising laboratory results, several limitations exist:

- **Bioavailability**: Many compounds are poorly absorbed or rapidly metabolized.
- **Standardization**: Variability in spice extracts complicates reproducibility.
- **Clinical Evidence**: Most studies are preclinical; human trials are sparse.
- **Safety**: High doses may cause side effects or interact with medications.

Future Directions

To fully harness the anticancer potential of spices, future research should focus on:

- **Advanced Formulations**: Liposomal, nanoparticle and adjuvant-enhanced delivery systems.
- **Large-scale Clinical Trials**: Rigorous studies to validate efficacy and safety.
- **Integrative Therapies**: Combining spices with conventional treatments for synergistic effects.

Conclusion

Spices like turmeric, ginger, garlic, cinnamon and black pepper offer more than flavour, they hold promise as natural agents in cancer prevention and adjunctive therapy. While they are not cures, their bioactive compounds align with key mechanisms in oncology: reducing inflammation, promoting apoptosis and inhibiting metastasis. Continued research may pave the way for their integration into evidence-based cancer care.

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