Evidence for Health Benefits of Ginger and Turmeric

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### Zingiberaceae family

Ayurvedic, Chinese, and Hindu medicine $^{1,2,3}$

**Ginger**  
(_Zingiber officinale_ Rosc.)

- Digestive disorders
- Nausea, morning sickness
- Arthritis
- Muscular discomfort
- Head aches
- Common cold
- Inflammatory conditions

**Turmeric**  
(_Curcuma longa_ L.)

- Respiratory conditions
- Liver disorders
- Rheumatism
- Diabetic wounds
- Cough & sinusitis
- Anorexia
- Abdominal pain
- Sprains
- Swelling

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Ginger
(Zingiber officinale Rosc.)

Therapeutic Effects

- Anti-oxidant
- Anti-platelet
- Anti-inflammatory
- Anti-tumorigenic
- Hypoglycemic
- Hypocholesterolemic
- Analgesic
- Anti-microbial activity

1. Ali et al., 2007
2. Cao et al., 1993
3. Nurtjahja-Tjendraputra et al., 2003
4. Thomson et al., 2002
5. Grzanna et al., 2004
6. Grzanna et al., 2005
7. Shukla et al., 2007
8. Kadrur & Goyal, 2005
9. Al-Amin et al., 2006
10. Pedov et al., 2002
11. Jagetia et al., 2003
12. Ficker et al., 2003
13. Mahady et al., 2003
Ginger
(Zingiber officinale Rosc.)

Non-volatile phytochemicals in ginger
Toxicity and safety of ginger

- Generally considered a safe herbal medicine.¹
- Minor adverse effects in humans
  - 400 mg ginger 3x/day for 3 weeks – 1/12 report of mild diarrhea²
  - Heartburn
  - Gastric irritant (>6g per day)
- Evidence for early embryo loss in pregnant mice given ginger tea³

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Turmeric
Curcuma longa L.

Therapeutic Effects

- Antioxidant\(^1-3\)
- Anti-inflammatory\(^4\)
- Anticarcinogenic\(^5\)
- Antimicrobial\(^6\)
- Hepatoprotective\(^7\)
- Thrombosuppressive\(^8\)
- Antiarthritic\(^9\)
- Cardioprotective\(^10\)

Turmeric
Curcuma longa L.

Curcumin identified as the active ingredient

3 major curcuminoids (3 – 5% of raw plant):
- Curcumin - Diferuloylmethane (77%)
- Demethoxycurcumin (17%)
- Bisdemethoxycurcumin (3%)
Molecular targets of curcumin

- Transcription factors
- Inflammatory cytokines
- Enzymes
- Kinases
- Genes regulating cell proliferation and apoptosis

1. Goel A. Biochemical Pharmacology, 2008, 75:787
Transcription factors regulate the expression of genes contributing to tumorigenesis, inflammation, cell survival, cell proliferation, invasion, and angiogenesis:

- NF-κB
- AP-1
- STAT proteins
- PPAR-γ
- B-catenin

Curcumin inhibits activation of transcription factors

1. Goel A. Biochemical Pharmacology, 2008, 75:787
Example:
Inhibition of inflammatory cytokine expression effects on cancer cells and renal failure:
- Inhibition of TNF-α downregulates NF-κB required for COX-2 protein expression
- Inhibition of TNF-α and IL-1β in chronic renal failure mouse models slowing renal failure

Curcumin inhibits expression of inflammatory cytokines

1. Goel A. Biochemical Pharmacology, 2008, 75:787
Example:
Regulates activities of enzymes that control cell/tumor growth and proliferation:
- Blocks fibrosis in glomerulonephritis by upregulation of hemoxygenase-1
- Suppress tumor cell growth by inhibiting FPTase activity
- Inhibit tumor promotion by inhibiting xanthine oxidase activity, a cause of PMA-mediated tumor promotion.

1. Goel A. Biochemical Pharmacology, 2008, 75:787
Curcumin down regulates the activity of multiple kinases:
Example:
- Mitogen-activated protein kinase (ERK1/ERK2, JNK, & P38 MAPK)
- EGF receptor-kinase
- Completely inhibits phosphorylase kinase, protein kinase C (PKC) among others

1. Goel A. Biochemical Pharmacology, 2008, 75:787
Curcumin effects targets controlling cell adhesion, apoptosis, and invasion. Example:

- Inhibits TNF-α induced expression of intracellular ICAM-1, VCAM-1 and E-selectin – adhesion molecules
- Anticancer effects via activation of p53 – intranuclear, tumor suppressor transcription factor.

1. Goel A. Biochemical Pharmacology, 2008, 75:787
Curcumin: bioavailability and safety

Poor Bioavailability

- Poor absorption with a major route of elimination in feces (up to 75%)
- Rapid metabolism in intestine and liver to glucuronide conjugates
- Curcumin metabolites found in plasma in low nanomolar range (3.6 – 12g daily)
- Increased absorption and inhibition of hepatic and intestinal glucuronidation when combined with piperine (2g/5mg).
Safety & Efficacy of curcumin in humans

- Doses up to 8 g daily for 3 months – no toxicity

- Studies testing maximal tolerated dose of curcumin up to 12 g; minimal adverse side effects, including diarrhea, rash, headache

- Special formulations of curcuminoids – 3600 mg for 4 months – diarrhea, nausea, alkaline phosphatase elevations.

- FDA has declared curcumin as “generally regarded as safe” (GRAS).

- Clinical trials to assess optimal dose, disease targets, and interactions with other drugs.

2. Lao et al., 2006
3. Sahrma et al., 2004
Conclusions

- Ginger and turmeric have health benefits
- Multiple metabolic targets identified through research
- Generally safe, but toxicity of future formulations requires study