

Curcuma longa (Turmeric): A Comprehensive Review of Raw and Processed Forms in Traditional and Modern Medicine across Human Organ Systems

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Abstract

Curcuma longa (turmeric), a member of the Zingiberaceae family, has been extensively used in **Ayurvedic, Siddha, Unani, and folk medicine systems** for centuries. Its rhizome, used in both **raw and processed (dried/powdered) forms**, contains bioactive compounds such as curcumin, demethoxycurcumin, and essential oils. This review evaluates the **phytochemistry, traditional applications, and modern pharmacological effects** of turmeric across major human organ systems. Recent studies demonstrate its **anti-inflammatory, antioxidant, antimicrobial, anticancer, neuroprotective, cardioprotective, and metabolic regulatory properties**. However, clinical translation is limited by poor bioavailability, which is improved through processing and formulation strategies. This article bridges ancient knowledge with contemporary biomedical research and highlights future therapeutic potential.

Keywords: *Curcuma longa*, curcumin, Ayurveda, organ systems, traditional medicine, bioavailability

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Introduction

Curcuma longa L., belonging to the Zingiberaceae family, has been extensively used as a medicinal herb, dietary spice, and coloring agent. In Ayurveda, turmeric is classified as a **Rasayana**, known for rejuvenation and disease prevention.

Traditional applications include:

- a) Treatment of skin diseases (Kushtha)
- b) Management of metabolic disorders (Prameha)
- c) Wound healing and detoxification

Modern pharmacological research attributes these effects primarily to curcumin, a polyphenolic compound with diverse biological activities [1].

The rhizome is used in: Raw form as fresh juice, paste, decoction & processed form as dried powder, extracts, oils.

Modern research identifies **curcumin** as the principal active compound responsible for many pharmacological effects¹³.

Phyto-chemistry

Chemical Constituents

- a) Curcuminoids (curcumin, demethoxycurcumin, bisdemethoxycurcumin)
- b) Volatile oils (turmerone, atlantone)
- c) Polysaccharides

Table 1 Raw vs Processed Turmeric

Content	Fresh Turmeric	Dried Turmeric
Curcumin Content	Relatively higher amounts of curcumin (reported up to about 70%)	Curcumin levels are reduced after processing(boiling & drying)
Essential Oils	Greater in fresh turmeric	Drying significantly lowers the essential oil content
Antioxidant Capacity	Stronger antioxidant activity	Dried samples generally show reduced antioxidant potential
Color	Typically appears brighter in color	Slightly dull in color
Amino Acids	Higher levels of essential and total amino acids	These amino acids decrease during the drying process

Role of Diet in the Prevention & Management of Hypertension

Taste	Has a mild, slightly ginger-like taste	Has a more bitter flavor
Flavor and Aroma	Fresh turmeric is mild, earthy, and slightly citrusy	Stronger, sharper, and more pungent smell and taste
Shelf Life	Limited storage period due to its high moisture content	Preserved for several months when stored in a cool, dry, and dark environment
Substitution Ratio	One tablespoon of freshly grated turmeric	one teaspoon of dried turmeric powder

Traditional and Folk Medicine Perspective

Use of *Curcuma longa* in

1. Ayurveda

- a) Anti-inflammatory (Shothahara)
- b) Blood purifier (Raktashodhaka)
- c) Digestive stimulant (Deepana)
- d) Pramehagna (Antidaibetic)
- e) Used for “Kushtha” (skin diseases), “Prameha” (diabetes), and wound healing
- f) Acts as anti-inflammatory, antiseptic, and detoxifier

2. Folk Medicine

- a) Paste applied topically for wounds, burns and infections
- b) Consumed with milk (“Haldi doodh”) for respiratory disorders
- c) Used in menstrual and liver disorders

3. Ethnomedicine

Turmeric has been used traditionally to treat:

- a) Digestive disorders
- b) Liver diseases
- c) Cough and cold
- d) Rheumatism ([Directory of Open Access Journals](#))

Effects of *Curcuma longa* on Human Organ Systems

Table 2: Organ System-wise Pharmacological Effects of *Curcuma longa*

Organ system	Traditional use	Evidence /clinical effect
Digestive	Improves digestion, liver tonic	Hepatoprotective, anti-ulcer [2]
Cardiovascular	Blood purifier	Lipid-lowering, anti-atherosclerotic [3]
Nervous	Brain tonic	Neuroprotective, anti-Alzheimer's [4]
Immune	Enhances immunity	Immunomodulatory, antimicrobial [5]
Endocrine	Diabetes management	Anti-diabetic, improves insulin sensitivity [3]
Musculoskeletal	Arthritis treatment	Anti-inflammatory, analgesic [6]
Respiratory	Cough, asthma	Anti-inflammatory, bronchodilator
Skin	Wound healing	Antimicrobial, anti-inflammatory
Reproductive	Menstrual regulation	Hormonal modulation (limited evidence)
Cancer	Tumor suppression	Anti-proliferative, apoptosis induction [7]

1. Digestive System

- a) Stimulates bile secretion and improves digestion
- b) Protects against ulcers and inflammatory bowel disease
- c) Shows hepatoprotective activity

Traditional use for indigestion and liver disorders is supported by modern studies.

2. Cardiovascular System

- a) Reduces cholesterol and triglycerides
- b) Improves endothelial function
- c) Anti-atherosclerotic effects

Curcumin helps reduce lipid levels and inflammation associated with cardiovascular disease¹².

3. Nervous System

- a) Neuroprotective effects in Alzheimer's and Parkinson's disease
- b) Reduces oxidative stress and neuroinflammation

Emerging research highlights its role in **neurodegenerative disease modulation**.

4. Immune System

- a) Immunomodulatory effects
- b) Enhances host defense against infections
- c) Antimicrobial and antiviral properties

5. Endocrine & Metabolic System

- a) Anti-diabetic activity (improves insulin sensitivity)
- b) Reduces metabolic syndrome markers

Evidence shows reductions in glucose, insulin, and lipid levels¹².

6. Musculoskeletal System

- a) Anti-inflammatory effects beneficial in arthritis
- b) Reduces pain and improves mobility

Clinical studies show efficacy in osteoarthritis management.

7. Respiratory System

- a) Used in asthma and cough
- b) Anti-inflammatory and bronchodilatory effects

8. Reproductive System

- a) Regulates menstrual disorders
- b) Used in traditional medicine for fertility and uterine health

9. Skin and Integumentary System

- a) Wound healing and antimicrobial effects
- b) Used in acne, eczema, and pigmentation

Traditional application as paste is widely practiced.

10. Cancer (Multisystem Impact)

- a) Anti-mutagenic and anti-proliferative effects
- b) Induces apoptosis in cancer cells
- c) Inhibits angiogenesis

Curcumin shows promise as an adjunct in cancer therapy¹⁰

Mechanism of Action of *Curcuma longa*

Curcumin exerts therapeutic effects through:

- Inhibition of **NF-κB pathway**

- Reduction of inflammatory cytokines (TNF- α , IL-6)
- Antioxidant activity (free radical scavenging)
- Modulation of signaling pathways (PI3K/Akt, MAPK)

Figure 1: Mechanism of Action of Curcumin

Curcumin

↓

Inhibits NF- κ B → ↓ Inflammation

↓

Scavenges ROS → ↓ Oxidative Stress

↓

Modulates signaling pathways → Cell survival regulation

Figure 2: Organ System Impact Overview

Brain → Neuroprotection

Heart → Lipid control

Liver → Detoxification

Pancreas → Glucose regulation

Joints → Anti-inflammatory

Skin → Healing

Immune → Modulation

Modern Research Evidence

Recent studies confirm:

1. Significant reduction in inflammatory markers
2. Improvement in metabolic syndrome parameters
3. Potential adjunct role in cancer therapy
4. Bioavailability remains a major limitation
5. Nanotechnology-based formulations are emerging

Recent reviews and meta-analyses indicate:

- a) Positive effects in **metabolic syndrome, arthritis, and inflammation**
- b) Potential benefits in **cancer, neurodegenerative, and cardiovascular diseases**
- c) Limitations due to **low bioavailability and variability in formulations**¹¹

- d) Advanced delivery systems (nanoparticles, liposomes) are improving clinical outcomes.

Safety and Toxicity

- a) Generally recognized as safe (GRAS)
- b) High doses may cause gastrointestinal discomfort
- c) Rare hepatotoxicity reported in supplements

Discussion

Turmeric demonstrates a strong correlation between traditional uses and modern pharmacological findings. Processed turmeric shows superior therapeutic efficacy due to improved absorption. However, lack of standardized dosing and variability in formulations remain challenges. Thermal processing methods such as boiling and drying can lead to a considerable loss of turmeric's nutritional and bioactive compounds.

Among different drying techniques:

1. Sun drying (SD) results in the greatest reduction of curcuminoids due to exposure to sunlight and ultraviolet radiation.
2. Hot-air drying (HD) at 50°C also decreases bioactive compounds, though less severely than sun drying.
3. Freeze drying (FD) better preserves phenolic compounds, flavonoids, and curcumin compared to other drying methods.

Studies comparing fresh turmeric with freeze-dried, hot-air-dried, and sun-dried samples show that fresh turmeric generally contains higher amounts of curcuminoids, phenolic acids, flavonoids, and amino acids. It also exhibits stronger antioxidant activity (measured by DPPH and FRAP assays), except in the ABTS assay.

The reduction in curcumin content varies by drying method:

1. Sun drying: approximately 72% decrease
2. Hot-air drying: approximately 61% decrease
3. Freeze drying: approximately 55% decrease

Health Benefits of Turmeric: - Turmeric is widely recognized for its health-promoting effects, including antioxidant and anti-carcinogenic activities. These properties contribute to its potential role in reducing the risk of cancer and cardiovascular diseases. The primary bioactive compounds responsible for these benefits are curcuminoids, along with phenolic acids and flavonoids, all of which exhibit strong biological activity⁸.

Turmeric represents a **bridge between traditional and modern medicine.**

While ancient systems recognized its broad therapeutic potential, modern science validates many of these claims through molecular and clinical studies.

Key considerations:

- a) Raw turmeric = traditional use, lower absorption
- b) Processed turmeric = higher efficacy, clinical relevance
- c) Need for standardized formulations

Conclusion

Curcuma longa is a versatile medicinal plant with therapeutic effects across multiple organ systems. Integration of traditional knowledge with modern scientific validation supports its role in preventive and therapeutic medicine. Future research should focus on clinical trials, formulation optimization, and molecular mechanisms.

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