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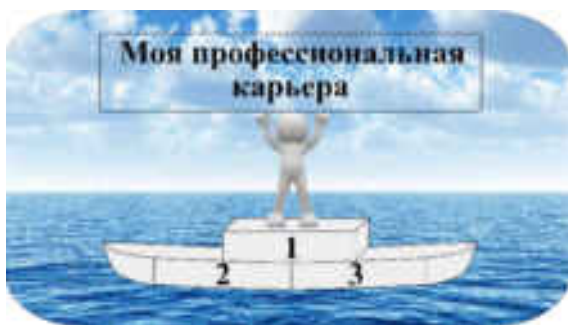


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**Международный научно-образовательный электронный журнал
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Название публикации: «PHYTOCHEMICAL ISOLATION OF CURCUMIN FROM
CURCUMA LONGA»

Abstract

Curcumin, the principal curcuminoid derived from *Curcuma longa* (turmeric), exhibits significant pharmacological activities, including antioxidant, anti-inflammatory, and anticancer properties. Efficient isolation of curcumin is critical for its application in pharmaceuticals, nutraceuticals, and functional foods. This study presents a comprehensive overview of phytochemical isolation techniques, including conventional solvent extraction, advanced extraction technologies, purification strategies, and analytical methods. Key process parameters influencing yield, purity, and stability are systematically evaluated.

1. Introduction

Natural products remain a major source of bioactive compounds in drug discovery. Curcumin (diferuloylmethane) is a polyphenolic compound responsible for the characteristic yellow color of turmeric rhizomes. Despite its therapeutic potential, efficient isolation is required to overcome challenges related to low bioavailability and co-extraction of impurities such as essential oils and other curcuminoids.

The objective of this study is to analyze and optimize the extraction and purification of curcumin from *Curcuma longa* using scalable and sustainable technologies.

2. Raw Material Preparation

2.1 Plant Material

- Rhizomes of *Curcuma longa*
- Harvest maturity significantly affects curcumin content

2.2 Pretreatment

- Washing and slicing
 - Drying at 50–60°C to reduce moisture (<10%)
 - Grinding to fine powder (particle size <0.5 mm)
-

3. Chemical Composition of Turmeric

- Curcuminoids (2–5%):
 - Curcumin (major)
 - Demethoxycurcumin
 - Bisdemethoxycurcumin
 - Essential oils (3–7%)
 - Polysaccharides and proteins
-

4. Extraction Technologies

4.1 Conventional Solvent Extraction

Solvents

- Ethanol, methanol, acetone, ethyl acetate

Process Parameters

- Temperature: 40–70°C
- Time: 2–6 hours
- Solid-to-liquid ratio: 1:10–1:20

Mechanism

Diffusion-based mass transfer of curcuminoids into solvent phase.

4.2 Soxhlet Extraction

- Continuous extraction using reflux system

- High efficiency but prolonged exposure to heat
-

4.3 Ultrasound-Assisted Extraction (UAE)

Mechanism

Cavitation enhances cell wall disruption and solvent penetration.

Advantages

- Reduced time (20–40 min)
 - Lower solvent consumption
 - Improved yield
-

4.4 Microwave-Assisted Extraction (MAE)

Mechanism

Rapid internal heating leads to rupture of plant cells.

Benefits

- High extraction efficiency
 - Short processing time
-

4.5 Supercritical CO₂ Extraction (SC-CO₂)

Conditions

- Pressure: 25–35 MPa
- Temperature: 40–60°C
- Co-solvent: ethanol (to improve polarity)

Advantages

- Solvent-free product
 - High purity
-

5. Purification of Curcumin

5.1 Filtration and Solvent Removal

- Rotary evaporation under reduced pressure

5.2 Column Chromatography

- Stationary phase: silica gel
- Eluent: hexane–ethyl acetate mixtures

5.3 Recrystallization

- Solvents: ethanol or acetone
- Produces high-purity curcumin crystals

5.4 Preparative HPLC

- Used for pharmaceutical-grade isolation

6. Analytical Characterization

6.1 High-Performance Liquid Chromatography (HPLC)

- UV detection at ~425 nm
- Quantitative analysis

6.2 UV-Visible Spectroscopy

- Characteristic absorption peak at 420–430 nm

6.3 Fourier Transform Infrared Spectroscopy (FTIR)

- Functional group identification

6.4 Mass Spectrometry (MS)

- Molecular weight confirmation

7. Process Optimization

Parameter	Optimal Range
Solvent type	Ethanol/acetone
Temperature	50–60°C
Extraction time	30–120 min
Particle size	<0.5 mm

Optimization methods:

- Response Surface Methodology (RSM)
- Kinetic modeling

8. Yield and Efficiency

Method	Yield (%)	Purity
Solvent extraction	Moderate	Moderate
Soxhlet	High	Moderate
UAE	High	High
MAE	Very high	High
SC-CO ₂	High	Very high

9. Applications of Curcumin

- Pharmaceutical (anti-inflammatory, anticancer agents)
- Nutraceuticals and dietary supplements
- Food industry (natural colorant E100)
- Cosmetics

10. Environmental and Economic Considerations

- Ethanol preferred as green solvent
- Reduction of toxic solvents
- SC-CO₂ considered environmentally sustainable
- Industrial feasibility depends on scale and cost

11. Conclusion

Efficient phytochemical isolation of curcumin from *Curcuma longa* requires the integration of optimized extraction and purification strategies. Advanced techniques such as UAE, MAE, and SC-CO₂ significantly improve yield and purity while reducing processing time and environmental impact. These technologies enable scalable production of high-quality curcumin for diverse industrial applications.

12. Recommendations

- Use ethanol-based extraction for food and pharmaceutical safety
- Apply ultrasound or microwave-assisted methods for efficiency
- Combine extraction with chromatographic purification for high purity

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