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UNLOCKING THE HIDDEN POTENTIAL OF IIIRD CROP CURCUMIN: A SCIENTIFIC APPROACH TO CURCUMIN HIGH-YIELD EXTRACTION

Dr. Prathvi Shetty, M. R. Shetty, Kumaraguru Kasinathan* and Keerthi P.

Department of Research and Development-Prakrutees Organics Pvt ltd.

***Corresponding Author: Kumaraguru Kasinathan**

Department of Research and Development-Prakrutees Organics Pvt ltd.

Email ID: rndtmk@prakrutees.com

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ABSTRACT

Curcumin, the primary bioactive compound in turmeric (Curcuma longa), is widely recognized for its potent antioxidant, anti-inflammatory, and therapeutic properties. Traditionally, the first and second crop materials from turmeric rhizomes are preferred for curcumin extraction, while the third crop is often discarded as waste due to perceived lower yield and inferior quality. This review challenges this perception by demonstrating that, through an optimized extraction process, IIIrd crop curcumin can yield a high curcuminoids assay of 87%. By refining extraction techniques and validating the purity through HPLC analysis, this study establishes IIIrd crop curcumin as a valuable and sustainable alternative for the nutraceutical and pharmaceutical industries.

KEYWORDS: “Third Crop Valorization”, Circular agriculture, Curcuminoids solubility, Sustainable-extraction.

1. INTRODUCTION

Turmeric is a rhizomatous herbaceous plant belonging to the ginger family (Zingiberaceae). It is widely cultivated in India, China, Indonesia, and other tropical regions for its medicinal, culinary, and industrial applications. The bright yellow-orange powder derived from its rhizomes has been used for centuries in Ayurvedic, Unani, and Traditional Chinese Medicine.

Curcumin is a well-researched natural polyphenol with a wide range of applications in medicine, nutraceuticals, food, and cosmetics. Its extraction from turmeric rhizomes typically focuses on the first and second crop materials, which are considered superior due to higher curcuminoids concentrations.

However, a significant portion of the biomass—the third crop—is often discarded or used for low-value applications due to assumptions about its lower quality. This study investigates whether IIIrd crop curcumin can be effectively extracted to produce a high-yield, high-assay curcuminoids extract that meets industry standards.

Active Compounds

The primary bioactive compounds in turmeric are curcuminoids, which include.

Curcumin (75–80%) – The main active compound responsible for its yellow color and medicinal properties.

A. Demethoxycurcumin

B. Bisdemethoxycurcumin

Turmeric also contains essential oils such as turmerone, ar-turmerone, and zingiberene, which contribute to its aroma and therapeutic effects.

1. OBJECTIVE

The primary objective of this study is to explore and optimize an extraction method that can maximize curcuminoids yield from 3rd crop material. By implementing a modified solvent extraction approach and validating the purity through HPLC analysis, this research aims to redefine the potential of IIIrd crop curcumin as a viable industrial raw material.

2. Materials and Methods for IIIrd Crop Curcumin Extraction

Materials

The raw material 60 kg used in this study was IIIrd crop curcumin material, often considered a byproduct of turmeric processing. The following chemicals and equipment were utilized.

- Ethanol (food/pharmaceutical grade) – used for initial extraction
- Acetone – used to enhance curcuminoids solubility

The following instruments were used in the extraction and analysis process.

- Naveen Rubber Lining Industrial Centrifuge Machine, Capacity: 15 To 200 Kg's Centrifuge used to separate curcuminoids-rich material

- BIO BEE Hot Air Oven – for controlled drying of the extract
- HPLC (High-Performance Liquid Chromatography) – to determine the curcuminoids assay

Fig: Third crop Curcumin.

METHODS

1. Extraction Process

Fresh Ethanol Shock (1:4 Ratio) – 2 Days
↓
Add Acetone (1:1 Volume) & Stir Continuously – 60 Minutes
↓
Keep the Mixture for 3 Days
↓
Centrifugation & Filtration – Collect Material
↓
Ethanol Wash – Remove Impurities
↓
Drying in Hot Air Oven – Obtain Final Extract

Fig: Flowchart representation of the 3rd Crop Curcumin Extraction Process.

2. Purification Process

- The solution was subjected to centrifugation to separate the solid fraction.
- The solid extract was collected through filtration and then washed with ethanol to remove impurities.

3. Drying and Storage

- The purified curcuminoids-rich extract was dried in a hot air oven at a controlled temperature until complete solvent evaporation.
- The dried material was stored in airtight conditions to prevent oxidation or degradation.

Fig: Curcumin after purification.

4. HPLC Analysis

- The final extract was analyzed using HPLC to determine curcuminoids content.
- The analysis confirmed an 87% curcuminoids assay, proving the efficacy of this extraction method.

3. **Potential Applications and Industrial Relevance**

The successful development of high-yield IIIrd crop curcumin opens new avenues for industrial applications, including:

A. Nutraceuticals: Inclusion in dietary supplements focused on anti-inflammatory and antioxidant benefits.
B. Pharmaceuticals: Potential for use in anti-cancer, anti-arthritic, and neuroprotective formulations.
C. Cosmetics: Applications in skincare and anti-aging products due to its antioxidant properties.
D. Food Industry: Use as a natural coloring and functional ingredient in health-focused foods.

4. **RESULTS AND DISCUSSION**

HPLC analysis of the extracted curcuminoids material demonstrated a curcuminoids assay of 87%, which is comparable to the yield from 2nd crop material and close to the industry- standard first crop extracts. This result contradicts the long-held belief that IIIrd crop curcumin is a low-value byproduct. The optimized extraction method not only improved yield but also ensured high purity, making 3rd crop curcumin a sustainable alternative.

5. **CONCLUSION AND FUTURE PERSPECTIVES**

This study provides compelling evidence that IIIrd crop curcumin should not be dismissed as a waste product but rather recognized as a valuable resource when processed using an optimized extraction method. The achievement of an 87% curcuminoids assay confirms its potential to meet industry standards, offering a more sustainable and cost-effective alternative to traditional curcumin sources. Further research should focus on process scalability, enhanced bioavailability, and broader commercial applications.

6. **CONCLUSION**

This optimized method provides a sustainable approach to extracting high-yield curcumin from IIIrd crop material, which is often considered waste.

By improving the extraction and purification process, high-quality curcuminoids can be obtained with an assay of 87%, making IIIrd crop curcumin a viable and cost-effective raw material for industrial applications.

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