

**MINOR PROJECTS UNDERTAKEN  
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# Extraction and Isolation of Curcumin from *Curcuma longa* L. and Package Turmeric powder.

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## 1 Introduction

Turmeric belongs to the perennial herb named *Curcuma longa* L. which is prevalent in tropical and subtropical regions, mostly in India, South East Asia and China. India is the first producer, consumer and exporter of *Curcuma longa* in the world<sup>1</sup>.

*Curcuma longa* L. is a highly branched standing plant with cylindrical rhizomes of yellowish to orange colour. Its broad long and simple leaves with long petioles (leaf stems) grow from branching rhizomes that lie just below the surface of the soil. Inflorescence is terminal, spike-shaped and cylindrical, having laterally green united bracts with reddish spots. It produces tall white flowers spikes. *Curcuma longa* L. rhizomes are yellowish to orange colour.

Turmeric, a vibrant golden spice, has been celebrated for centuries not only for its culinary uses but also for its potential health benefits. Turmeric is commonly called “haldi,” in North India, a word derived from the Sanskrit word *haridra*, and in the south it is called “manjal,” a word that is frequently used in ancient Tamil literature.

Turmeric is a plant that has a very long history of medicinal use, dating back nearly 4000 years. In Southeast Asia, turmeric is used not only as a principal spice but also as a component in religious ceremonies. Because of its brilliant yellow colour, turmeric is also known as “Indian saffron.” Modern medicine has begun to recognize its importance, as indicated by the over 3000 publications dealing with turmeric that came out within the last 25 years.

India produces nearly all of the world’s turmeric crop and consumes 80% of it. With its inherent qualities and high content of the important bioactive compound curcumin, Indian turmeric is considered to be the best in the world. Erode, a city in the South Indian state of Tamil Nadu, is the world’s largest producer and the most important trading centre for turmeric. It is also known as “Yellow City,” “Turmeric City,”

Research studies have shown some possible benefits of turmeric for Inflammation, Degenerative eye condition, Arthritis, muscle sore after exercise and kidney health (John Hopkins medicine)<sup>2</sup>. Curcumin, also known as diferuloylmethane, which is a highly pleiotropic molecule, have exhibited numerous health benefits. Reported medical properties of curcumin such as anti inflammatory<sup>3</sup>, antibacterial<sup>4</sup>, antidepressant<sup>5</sup>, antidiabetic<sup>6</sup>, antitumor<sup>7</sup>, immunomodulatory<sup>8</sup> and gastroprotective properties<sup>9</sup> are well documented. It is also known for its antioxidant properties<sup>10,11-14</sup>, its anti microbial activities, hyperlipidemia<sup>15-17</sup> (cholesterol in blood) aiding in wound healing.

Besides the reported medicinal properties of turmeric, the skin enhancing properties of turmeric is also well documented. Traditionally, turmeric paste is applied to the skin of the bride and groom before marriage in some parts of India, Bangladesh, and Pakistan, where it is believed to make the skin glow and keep harmful bacteria away from the body.

Recent research papers have corroborated its traditional importance; it helps to manage several skin issues like signs of aging<sup>18</sup>, pigmentation, acne<sup>19</sup>, lightening of the skin<sup>20</sup> and hyperpigmentation, reduces black circles and puffiness<sup>21</sup>,

Besides its medicinal uses, turmeric is also used as a flavouring agent, dye, and a food colouring agent.

However, despite proven efficacy against numerous experimental models, poor bioavailability due to poor absorption, rapid metabolism, and rapid systemic elimination have been shown to limit the therapeutic efficacy of curcumin.

Among the different varieties of turmeric, Lakadong variety (*Curcuma longa* L.) is found to have the highest curcumin content, 3 times more than other varieties grown worldwide. Lakadong variety of turmeric is reportedly found only in Lakadong village, Jaintia hills, Meghalaya.

At the heart of this miraculous spice lies curcumin, a bioactive compound found in the roots of *Curcuma longa* L. Curcumin is an orange-yellow crystalline powder. In recent years, the extraction of curcumin from turmeric has gained significant attention due to its numerous applications in pharmaceutical, food and cosmetic industries.

The natural and major bioactive compounds of the *Curcuma longa* L. plant are Curcuminoids. Curcumin is found primarily in roots and rhizomes of the turmeric plants. In addition to curcumin, two other curcuminoids occur in lesser amounts in turmeric, namely demethoxycurcumin (DMC) and bisdemethoxycurcumin (BDMC)<sup>22</sup>.

## Curcuminoids

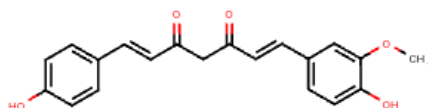
### 1. Demethoxycurcumin

Molecular formula: C<sub>20</sub>H<sub>18</sub>O<sub>5</sub>

Melting point: 170 – 180 °C

Molecular mass: 338.35 g/mol

(IUPAC): (1E,6E) -1-(hydroxyl -3-methoxyphenyl) -7-(4-hydroxyphenyl)hepta-1,6-diene-3,5-dione.



Demethoxycurcumin has a role as a metabolite, an antineoplastic agent and an anti-inflammatory agent<sup>8</sup>.

### 2. Bisdemethoxycurcumin

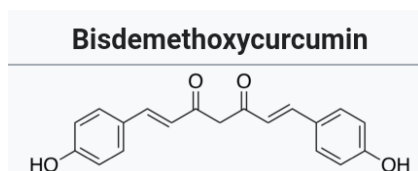
IUPAC: Bisdemethoxycurcumin (1E,6E) – 1,7 – Bis(4-hydroxyphenyl)hepta – 1,6 – diene – 3,5 – dione.

Bisdemethoxycurcumin is beta-diketone

Melting point: 226 – 231°C

Molecular mass: 308.33 g/mol

Molecular formula: C<sub>19</sub>H<sub>16</sub>O<sub>4</sub>



Bisdemethoxycurcumin has a role as a metabolite and an alpha amylase inhibitor<sup>7</sup>.

### 3. Curcumin

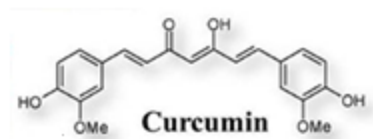
Curcumin is a diferuloylmethane with a crystalline yellow-orange colour.

Molecular mass – 368.38 g/mol

Melting temperature: 183°C

Chemical formula: C<sub>21</sub>H<sub>20</sub>O<sub>6</sub>

IUPAC: (1E, 6E)-1, 7-bis (4-hydroxy-3-methoxyphenyl) hepta-1, 6-diene-3, 5-dione.



Curcumin is a natural dyestuff found in the roots of *Curcuma longa* L. It has a role as a metabolite, anti inflammatory agent, an antineoplastic agent, a hepaprotective agent, a flavouring agent, a biological pigment, a nutraceutical, an antifungal agent, a dye, a lipoxygenase inhibitor, a ligand, a radical scavenger, a contraceptive drug, a histone deacetylase inhibitor, an immunomodulator, an iron chelator, a neuroprotective agent, a food colouring, an aldehyde reductase inhibitor, a shikimate dehydrogenase inhibitor, an IMP dehydrogenase inhibitor, a NAD(P)H dehydrogenase(quinine) inhibitor, a thioredoxin reductase inhibitor, a non-specific protein-tyrosine kinase inhibitor and a geoprotector. Curcumin, also known as diferuloylmethane. It is a highly pleiotropic molecule that exhibit antibacterial, anti inflammatory, antioxidant, wound healing and anti microbial activities. Despite proven efficacy against numerous experimental models, poor bioavailability due to poor absorption, rapid metabolism, and rapid systemic elimination have been shown to limit the therapeutic efficacy of curcumin<sup>23</sup>.

**Objective: Extraction and separation of Curcumin from turmeric samples.**

## 2 Materials and methods:

### 2.1 Extraction of Curcumin.

**2.1.1 Substrate: Sample A;** *Curcuma longa* L (turmeric) is local variety collected from Jaintia Hills, Meghalaya. Fresh rhizomes of turmeric were used for extraction. **Sample B;** powdered packet turmeric (Everest brand) which was bought from the market and used for extraction. **(Figure 1)**

**2.1.2 Materials:** Soxhlet extractor - 40 mm ID, with 500-mL round bottom flask, Paper thimble, Heating mantle - Rheostat controlled, Disposable glass Pasteur pipette and bulb. Drying oven, Desiccator, Hot Plate - Rheostat controlled and Analytical balance - capable of weighing to 0.001 g.

**2.1.3 Reagents:** Extraction solvents – Ethanol, TLC Solvents – Methanol, Chloroform.

#### 2.1.4 Method of Extraction:

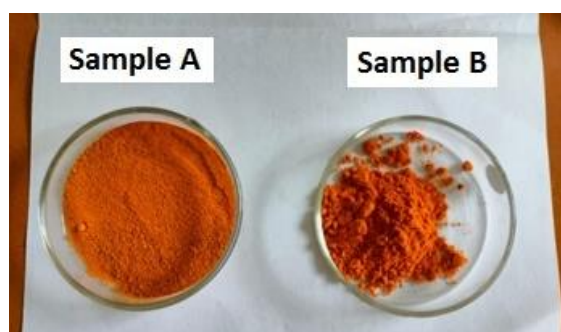
Curcuminoids was extracted by Soxhlet extraction method. 10 gm of powdered turmeric samples, A and B were wrapped in filter paper and placed inside separate thimbles. The thimble containing sample A was then placed in a Soxhlet apparatus; 650 ml of solvent was added and extracted according to their boiling point for seven hours. The solvent used for extraction was ethanol. (BP – 65°C). **(Figure 2)** After completion of extraction the dark brown extract was then cooled, concentrated on a hot plate at 40°C. **(Figure 3)** This crude dried extract which was turning black orange in colour **(Figure 4, 5)**. The same extraction method was repeated for sample B and yield was calculated.

Calculate the % dry weight as follows:

% of curcumin = Dry weight of extracted curcumin/Total wt of turmeric.

**Table 1: Percentage of Curcumin**

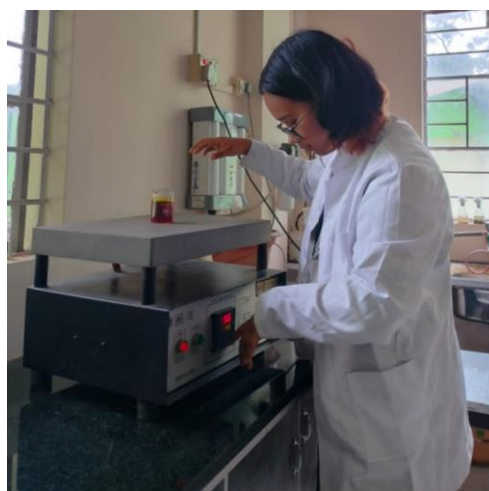
	Sample A	Sample B
Dry Weight of extracted Curcumin	1030 mg	990 mg
Total Weight of Turmeric	10 g	10 g
Percentage of Curcumin	10.3 %	9.9 %



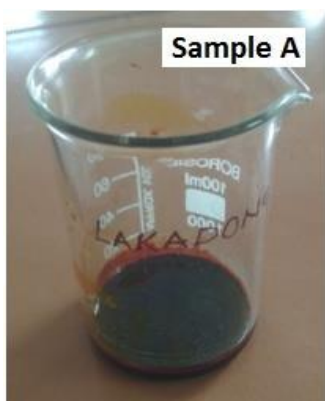
**Figure 1: Powered Samples**



**Fig2: Soxhlet extractor unit**



**Figure 3: Concentration of Curcumin**



**Figure 4: Extracted Curcumin of Sample A**



**Figure 2: Extracted Curcumin of Sample B**

## 2.2 Separation of curcumoids by TLC

The mobile phase was prepared using ethanol. Samples was run on TLC (**Figure: 6**) and we got three different single spots of Curcumin, Demethoxycurcumin, and Bisdemethoxycurcumin (**Figure: 7**).

### Separation of curcuminoids by TLC

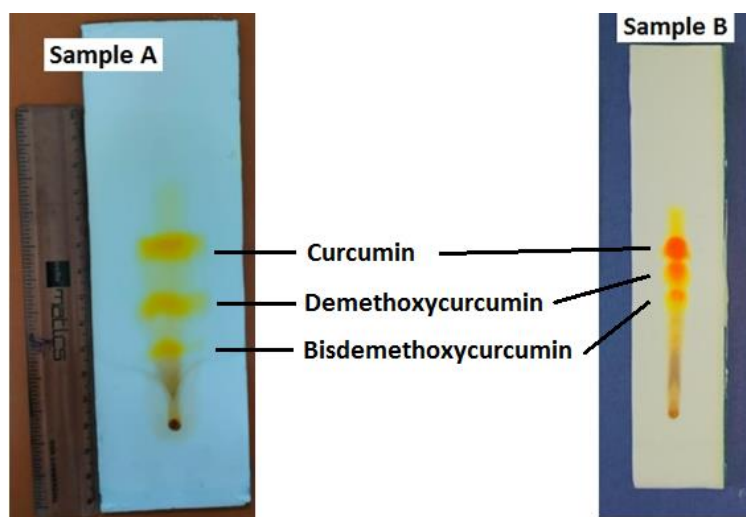
Chloroform and Methanol solvent extracts were tested on TLC for presence of different curcuminoids. The thin layer chromatography pre-coated silica gel plates were used. These plates were developed using glass beaker, which was pre- saturated with mobile phase for 20 mins and each plate was developed up to a height of about 6.8 cm. Chloroform: methanol mobile phase was used with the 95:5 composition. After development of chromatogram, plated were removed, dried and spots were analyzed.



**Figure 6A: Preparation TLC plates**



**Figure 6B: Loading of TLC plates**



**Figure 7: TLC plate with samples A and B**

**Bisdemethoxycurcumin**

Molecular mass: 308.33 g/mol

**Demethoxycurcumin**

Molecular mass: 338.35 g/mol

**Curcumin**

Molecular mass – 368.38 g/mol

**Results and Discussion:**

The total yield of extracted curcumin determined by Soxhlet extraction for sample A and sample B was 10.3 % and 9.9 % respectively.

In this study, it is confirmed that *Curcuma longa* L., of Lakadong variety having higher amount of curcumin compared to the marketed packet powdered Turmeric (Everest brand). With respect to curcumin extraction, solvent (ethanol) played a major role for maximum recovery of curcumin. Dried curcuminoids samples were run on TLC plates for separation of curcuminoids, which showed three different spots of curcumin, di-methoxy-curcumin, and bis-demethoxy-curcumin whose Rf values calculated are 0.5, 0.67 and 0.83 as curcumin, di-methoxy-curcumin, and bis-demethoxy-curcumin respectively.

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