

Research Article

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## Extraction, Characterization, and Usage of Turmeric Curcumin for Color Coating of Metronidazole Tablets

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### Abstract

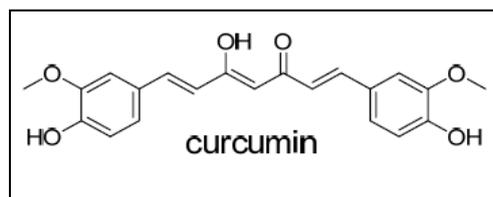
Curcumin is a chemical compound produced by *Curcuma longa* plants that is widely used as a coloring agent and a dietary supplement and has some therapeutic activity. Our aim is to evaluate the use of curcumin as color coating material for metronidazole tablets. Curcumin was extracted at higher yields from three different samples of turmeric plants. The extract obtained was characterized by Infrared Red Spectroscopy (IR), Thin Layer Chromatography (TLC) and ash content and melting point (MP). The curcumin produced has an MP content ranging from 182 ° C to 184 ° C and an ash content ranging from 1.5 to 3.17 %. Curcumin material was used as a colorful agent for the coating of metronidazole tablet pills using spray coating technology. Experimental results have shown that curcumin-coated metronidazole tablets exhibit strong color stability even at higher temperatures, and that the taste of bitterness in metronidazole pills has been reduced or has disappeared entirely.

**Keywords:** Curcumin, Turmeric, Color-coating, Metronidazole tablets, Pharmaceutical.

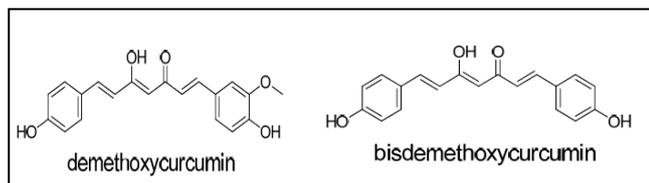
### Introduction

Scientific research on color chemistry is needed to improve and maintain color stability. Natural coloring additives are generally considered to be coloring additives derived from plant or animal sources by extraction or other physical processing[1,2]. Examples of natural colorants include carmine, annatto extract, grape skin extract, turmeric, saffron and beta-carotene, which are the major natural color additives used in food products. Synthetic coloring additives include chemically synthesized substances such as tartrazine, erythrosine and indigo carmine. Natural or vegetable colors are less in use because they are expensive or difficult to extract [1, 2]. Curcumin (synonyms: turmeric yellow, kurkum, INS No. 100(i)) is an orange-yellow crystalline powder.

The standards of the Joint Expert Committee on Food Additives (JECFA) define only curcumin extracted from natural source materials. It may also be produced by chemical synthesis, which is not used as a food additive [3]. The chemical structure of curcumin is shown in **Figure 1**. The yellow coloring components (curcuminoids) and the primary coloring pigment are curcumin (CurI), along with two additional minor curcuminoids, demethoxycurcumin (CurII) and bisdemethoxycurcumin (CurIII), which are the key active constituents of the turmeric (**Figure 2**). Curcumin is a major secondary metabolite of the perennial Asian plant turmeric (*Curcuma longa* L). Curcumin was identified as the active principle of turmeric in 1815 and its structure was determined after crystallization in 1870 [4]. Turmeric is only one representative of more than 80 species of turmeric in the ginger family, Zingiberaceae [5].



**Figure 1:** The chemical structure of curcumin.



**Figure 2:** Structure of the minor curcuminoids.

Turmeric is widely cultivated in many Asian countries, particularly India, where it is mainly grown for dietary use and is a major component of the spice curry. In addition, turmeric is recognized for its medicinal properties and has been used for centuries in the treatment of a variety of diseases including eczema, arthritis, ulcers, asthma, anemia and many others [6]. As a result of extensive studies over the last few decades, curcumin has emerged as a promising anti-cancer agent and has been shown to target multiple and diverse pathways of disease causation and progression [4]. The attractiveness of curcumin as a therapeutic agent is enhanced by its safety, affordability, and history of long-term use [7]. Molecular formula of C<sub>21</sub>H<sub>20</sub>O<sub>6</sub>, corresponding to a molecular weight of 368.37.

Curcumin is a yellow-orange crystalline powder with maximum absorbance at 430 nm and melting point of 183 °C [6]. Curcumin exhibits hydrophobic and (slight) hydrophilic properties owing to its aliphatic heptadienone linker and polar β-dicarbonyl and phenolic groups, respectively [8]. Curcumin is sparingly soluble in water, but shows greater solubility in some organic solvents such as acetone, ethyl acetate, acetonitrile and ethanol. Its reported partition coefficient (Log P) ranges from 2.5 to 3.3 [9]. Curcumin is a bis-α,β-unsaturated β-diketone and exists in equilibrium with its enol tautomer [10]. Studies involving <sup>1</sup>H, C NMR, and infrared spectroscopy have shown that the enolate form predominates in alkaline solution [11].

No previous literature has introduced the use of curcumin as a color coating for metronidazole tablets. The aim of this study is to extract and characterize curcumin obtained from the turmeric plant using different analytical techniques and to evaluate the use of turmeric powder as a coating material for metronidazole tablets. In addition, we studied the effect of this coat material on some of the properties of the metronidazole tables.

## Materials and Methods

Turmeric samples were collated from Sudanese local market.

**Curcumin extraction:** Twenty grams of ground turmeric in 50 mL of dichloromethane was magnetically stirred and heated at the reflux condenser for 1 h. The mixture was then suction-filtered and the filtrate was concentrated in a hot water bath maintained at 50°C. The reddish yellow oily residue was treated with 20 ml hexane and the resulting solid was collected by suction filtration [3]. The obtained yield was calculated as follow: Yield = W<sub>pr</sub>/W<sub>theo</sub>X100  
Where: W<sub>pr</sub> = practical weight, W<sub>theo</sub> = theoretical weight

### Fourier Transform Infrared Spectroscopy (FT –I R):

Two milligrams of curcumin were mixed with 300 mg of dried potassium bromide. Carefully, the mixture was grinded, spread evenly in an appropriate die and subjected to a pressure of approximately 800 MPa (8 t·cm<sup>-2</sup>). In the case of substances that were unstable under normal atmospheric conditions, the disc was pressed into a vacuum. A disc was rejected if visual examination had been show lack of uniform transparency or when transmittance at 2000 cm<sup>-1</sup> (5 μm) in the absence of a specific absorption band was less than 60 per cent without compensation, unless otherwise prescribed. Samples were prepared by the same procedure and the spectrum was recorded between 4000- 400 cm<sup>-1</sup> (2.5-15.4 μm) under the same operational conditions. The transmission minima (absorption maxima) in the spectrum was obtained with the substance to be examined correspond in position and relative size to those in the spectrum obtained with the reference substance [12].

### Thin Layer Chromatography (TLC):

The solvent system which was used to characterize of curcumin powder was prepared by mixed of (3% methanol and 97% dichloromethane). The diameter of TLC plate had 10X20 cm<sup>2</sup> [3].

### Melting point (MP):

A sufficient quantity of curcumin was introduced into the capillary tube to give a compact column of 4 mm to 6 mm in height. The temperature of the bath was increased to about 10°C below the assumed melting point and the heating rate was adjusted to about 1° C/min. When the temperature was 5°C below the assumed melting point, the capillary tube was introduced into the instrument. In the case of the apparatus described above, the capillary tube was immersed in such a way that the closed end is near the center of the thermometer bulb, the immersion mark of which is at the surface level of the liquid. The temperature at which the last particle was transferred to the liquid phase was recorded [12].

**Ash content:** The porcelain crucible was ignited at  $600 \pm 50$  °C for 30 min and then allowed to cool over the silica gel in the desiccators. The prescribed amount of curcumin was placed in the crucible and weighed, after it had been gently heated to low temperatures as practicable, until the sample had been thoroughly charred, until white fumes had ceased to develop and ignited at  $600 \pm 50$  °C until the residue had been completely incinerated. The crucible was allowed to cool over the silica gel in the desiccator, was weighed again and the percentage yield was calculated [12].

**Percentage of whiteness:** The sample powder was placed in dishes, regularly highlighted and then the color was measured against the white color standard and the percentage was finally recorded.

**Coating of metronidazole tablets with curcumin:** A total of 25 g of Opadry white was dissolved in 500 ml of ethanol with stirring during 30 min. and 1 g of curcumin powder was added during 10 min. The spray coating process for metronidazole tablets began by placing the tablets in the coating machine chamber, and then the main unit button was pressed. The exhaust was operated until the powder was removed from the tablets and the hot air was operated until the temperature of the tablet reached 50°C. The temperature control key was operated with hot air to control the temperature of the coating. The spray stage was then operated, and the turn sprayers were opened until the tablets were completely coated. And after coating, the other keys were turned off until the tablets had dried. The coating machine was stopped; the tablets were removed [12].

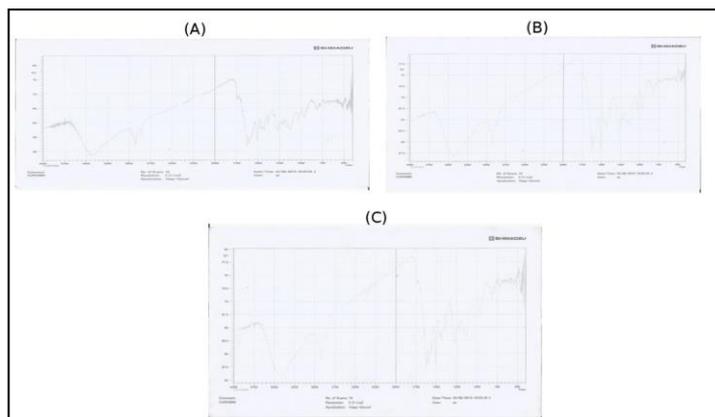
## Results and Discussion

The turmeric plant can be identified both by its characteristic tuberous root and by the leaves which extend upward from the erect, thick stems of the root. Turmeric root has a fragrant aroma and a slightly bitter, peppery, biting taste reminiscent of ginger. When eaten, it colors the saliva yellow and leaves a warm feeling in the mouth. The curcumin yields obtained for the different samples are shown in **Table 1** and the resulting compounds were finely soft, clear yellow powder. The yield of the samples was consistent with the method described by Andrew *et al*, [3], and the appearance of the powder was as clear as the standard colour.

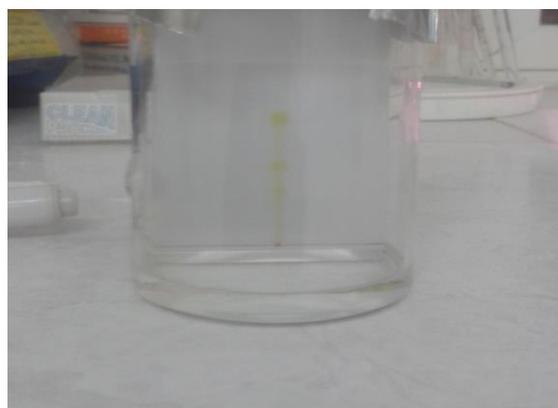
**Table 1:** The Curcumin yield (CY), Melting point (MP), Ash Content (AC) and Percentage of Whiteness (PW) of the studied tumeric samples.

Samples Number	CY	MP	AC	PW
1	86.36%	183°C	1.50%	52.04%
2	81.81%	184°C	3.09%	53.03%
3	82.72%	182°C	3.17%	51.08%

**Figures 3** show the absorption of samples. These Figures contain the following characteristic peaks: the broad band of the three OH groups at  $3250-3500\text{ cm}^{-1}$ , sharp peak Stretch of C- H aliphatic system less than  $3000\text{ cm}^{-1}$ , weak peak of C-H aromatic system around  $3050\text{ cm}^{-1}$ , sharp peak of C=O at  $1510\text{ cm}^{-1}$ , medium peak of C-O at  $1300\text{ cm}^{-1}$ , and sharp peak of C=C of aromatic system at about  $1510\text{ cm}^{-1}$ . **Figure 4** shows the TLC plate of the compound. The chromatogram obtained showed that curcumin was divided into three distinct compounds. Clearly, this result is in agreement with Andrew *et al.*, [3].



**Figure 3:** IR spectrum analysis results of curcumin for samples 1 (A), 2 (B) and 3 (C).



**Figure 4:** TLC of curcumin sample.

The melting point determined by the capillary method and it is the temperature at which the last solid particle of a compact column of a substance in a tube passes into the liquid phase. The results of the three samples are shown in **Table 1**. The melting point of curcumin is 183°C (BP2012)[12]. The ash content obtained of the samples ranges from 1.5 to 3.17 % (**Table 1**). In summary, from the three samples above, the percentage of Ash in curcumin was good. The percentage of whiteness of the three samples obtained ranges from 51.08% to 53.03% (**Table 1**).

Coated tablets are tablets containing one or more layers of mixtures of different substances, such as natural or synthetic resins, gums, gelatin, inactive and insoluble fillers, sugars, plasticizers, polyols and waxes. Coloring matter authorized by the competent authority and sometimes flavorings and

active substances. The mean weight and disintegration time of metronidazole tablets prior to coating with curcumin was 323.0 mg and 23 sec and 22 sec respectively. However, the average weight and disintegration time after coating was 324.74 mg and 120 sec, 93 sec and 114 sec respectively (**Figure 5**).



**Figure 5:** Metronidazole tablets before (A) and after blistering.

## Conclusion

The primary purpose of the study in this study is to study the isolation of curcumin from turmeric and also to characterize curcumin as a color-coating material for metronidazole tablet in pharmaceuticals. Curcumin was extracted from the turmeric in a simple and easy way using dichloromethane and triturated with hexane, and the extraction yield was finely soft yellow powder. Experimental results have shown that curcumin-coated metronidazole tablets exhibit strong color stability even at higher temperatures, and that the taste of bitterness in metronidazole pills has been reduced or has disappeared entirely.

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