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Research Article

# CHARACTERIZATION OF B-CYCLODEXTRIN COMPLEXES WITH NATURAL DYE

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**ABSTRACT**

Many recent reports on curcumin, a polyphenol from *Curcuma Longa*,provide mounting evidence on the pharmacological activity of this natural product. However,the pharmaceutical use of this molecule is hampered due to its poor solubility in the aqueous media,inclusion complex formation with cyclodextrins has been reported as a means to enhance its aqueous solubility. Most of the studies provide Infrared (IR) spectroscopic data as an evidence to support inclusion complex formation.In this study,fully water soluble complexes of curcumin with two β-cyclodextrins were isolated and characterized.

**Keywords**: Natural dye, β-cyclodextrin, Hydroxyl propyl β-cyclodextrin, FTIR.

## 1. INTRODUCTION

Turmeric, derived from the rhizome of *Curcuma Longa* has been used by people of Indian subcontinent for centuries with no known side effects,not only as a component of food but also for a wide verity of ailments[1].Curcumin is the photochemical that gives yellow colour to turmeric. Extensive research within the last half century has proven that most of these activities,once associated with turmeric are due to curcumin[2].Curcumin is reported to have a number of pharmacologicalactivities including antioxidant,HIV anti proteases activity,anti-inflammatory, analgesic,anticancer,etc.,[3].Of late,its potent antiamyloidogenic effects in treatingAlzheimer's disease have ignited wide spread research interest on this drug[4].Pre-clinical and chemical trials have revealed that curcumin is safe even up to a dose level of 8.0g and this makes it all the more important[5].But the pharmaceutical use of this pharmacologically potential molecule is restricted due to its poor aqueous solubility resulting in reduced bio availability[6].

One way to increase its aqueous solubility is to form inclusion complex i.e., to encapsulate curcuminas aguest within the internal cavity of a water soluble host[7].Cyclodextrin have been used extensively in pharmaceutical research and development, and there are productsnumerous cyclodextrin containing pharmaceutical marketed worldwide[8].The most common pharmaceutical application of CDs is to enhance drug solubility in aqueous solutions.CDs are also used for increasing stability and bioavailability of drugs, and other additional applications[9].Many studies on enhancement of solubility of curcumin with cyclodextrin have been reported[10-13].Recent reports on curcumincyclodextrin complexes show the vast amount of research going on in this field worldwide[14-17]. In recent papers[15-16] also FTIR spectroscopy was used for studying the complex formed between curcumin and hydroxyl propyl β-cyclodextrin.

## 2. EXPERIMENTAL

Curcumin (1, 7-bis (4-hydroxy-3-methoxyphenyl)-1, 6-heptadiene-3, 5-Dione), β-Cyclodextrin and Hydroxyl Propyl β-Cyclodextrin were purchased from Sigma Aldrich Company Bangalore. The chemicals were used without further purification.FTIR spectra of curcumin,cyclodextrinsand the physical mixtures complexes were recorded using **Thermonicolet iS5 FTIRspectrometer**. The scanning range used was 400-4000 $cm^{-1}$.

## 3.RESULT AND DISCUSSION

Although many studies have been carried out on curcumin-cyclodextrin complexes, characterization of fully water soluble

complexes have not been reported yet.Characterization techniques used in earlier studies especially FTIR,could not provide adequate evidence for inclusion complex formation [15, 16].The method used for preparing inclusion complexes is another important factor to be considered. In the present study,the soluble curcumin-cyclodextrin complexes were filtered through 0.45 µm fitter in order to remove any insoluble curcumin present. The filtrate thus obtaining was freeze dried to obtain solid complexes. In all earlier reported studies the investigations had not filtered out their complexes with curcumin and as a result the characterized products were mixtures of uncomplexed curcumin, complexed curcumin and uncomplexed cyclodextrin. Due to this reason FTIR spectral study used in the earlier reported works is not likely to provide adequate information on the inclusion complex formation.

### 3.1.FTIR spectrum of curcumin

A detailed study on the vibration spectra of curcumin has been reported earlier by Kolevetal[18].The FTIR spectrum of curcumin is shown in Fig.1.The sharp peak at 3435 $cm^{-1}$ indicates the presence of OH .The strong peak at 3001 $cm^{-1}$ attributed to CH stretching. The 1492 $cm^{-1}$ peak is assigned to the γ (C-H) bending, while, OH bend was obtained at 1423$cm^{-1}$ C-O stretching at 1317 $cm^{-1}$,C-O-H stretching was observed at 1234 $cm^{-1}$ and C-H bending at 690 $cm^{-1}$.

### 3.2 FTIR spectra of cyclodextrins

The overlaid FTIR spectra of βCD and HβCD are given in Fig.2. The FTIR peaks of the two β-cyclodextrins are almost identical with slight variations in their intensities.The OH group stretching.The H-bonded OH stretching observed at 2455 $cm^{-1}$ and C=O asymmetrystretching at 1797 $cm^{-1}$.Since there are no significant variations in the spectra of different cyclodextrinscomplexes of curcumin with cyclodextrinswere selected for detailed analysis.

### 3.3 FTIR spectra of (Cur+ βCD) and (Cur+HβCD) complexes

FTIR spectra of curcumin,mixture of curcumin and βCD and the mixture of curcuminand HβCD are shown in Fig.3.The peak assignments of all the spectra are given in Table.1.A little significant changes in the IR spectraof complexes have been observed,show the complex formation of β -cyclodextrins and curcumin.All the major peaks of curcumin are hidden by the cyclodextrin peaks in the similar region.

### 4. CONCLUSION

FTIR spectroscopy provided clear and distinct evidence for inclusion complex formation of curcumin with β-cyclodextrin and hydroxyl propyl β -cyclodextrin. Complexes were found to be formed when βCDs and curcumin were taken in the ratio 1:1.

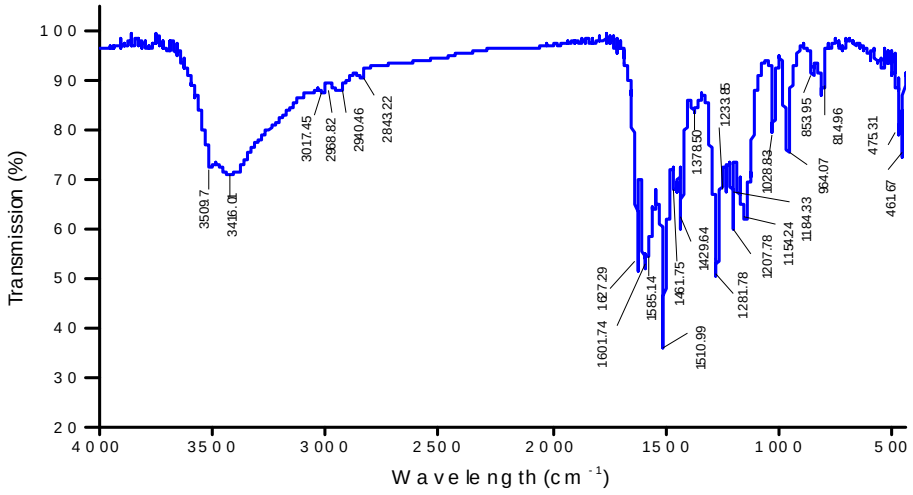


**Fig. 1: FTIR spectrum of curcumin**

**Table 1: FTIR peak assignment of curcumin, βCD, HβCD and complexes**

| Curcumin | βCD ($\gamma cm^{-1}$) | HβCD ($\gamma cm^{-1}$) | Cur+βCD ($\gamma cm^{-1}$) | Cur+HβCD ($\gamma cm^{-1}$) | Peak assignment |
|---|---|---|---|---|---|
| 3509.7 | 3425.58 | 3435.22 | 3429.43 | 3433.29 | OH stretching of phenol group<br>OH stretching |
| 2968.82 | 2921.37 | 2921.37 | 2935.30 | 2937.30 | Asymmetric CH stretching OF $CH_3$ |
| 2940.46 | 1656.85 | 1658.78 | 1656.85 | 1656.85 | CH stretching of OCH3 |
| | | | | | Asymmetric CH stretching OF $CH_2$ |
| 1627.29<br>1601.74 | 1423.47<br>1186.22 | 1433.11<br>1026.13 | 1423.47<br>1317.38 | 1423.47<br>1317.38 | HOH of water of crystallization, C=C stretching |
| 1510.99 | 1029.99 | 952.84 | 1188.15 | | |
| 1429.64 | 948.98 | 801.75<br>763.81 | | | C=O,Cring-C=C stretching<br>Aromatic C=C stretching |
| 1281.78 | 813.96<br>705.95 | 704.02 | 1033.85<br>948.98 | 1037.70 | C=O stretching, CCC,CC=O in plane bending<br>In plane bending of aromatic (CCC,CCH), enolic (COH),CH in plane |
| 1154.24 | | | | 948.98 | In plane bending of CH, enolic COH, skeletal CCC<br>CH in plane bending of C=CH, aromatic C-O stretching |
| 1028.83 | | | | | CH overtone stretching C-O-C stretching<br>In plane bending of aromatic CCH, skeletal CCC |
| 853.95 | | | | | C-O,C-C,CCO,C-O-C stretching of glucose units<br>C-O-C stretching out of plane of CH3,in plane bending of aromatic CCH<br>C=O stretching, in plane bending of CCH<br>CH out of plane of aromatic CCH<br>C-O-C stretching<br>Skeletal C-C stretching CH out of plane bending<br>In plane bending of skeletal CCH and aromatic CCH, C=C stretching |

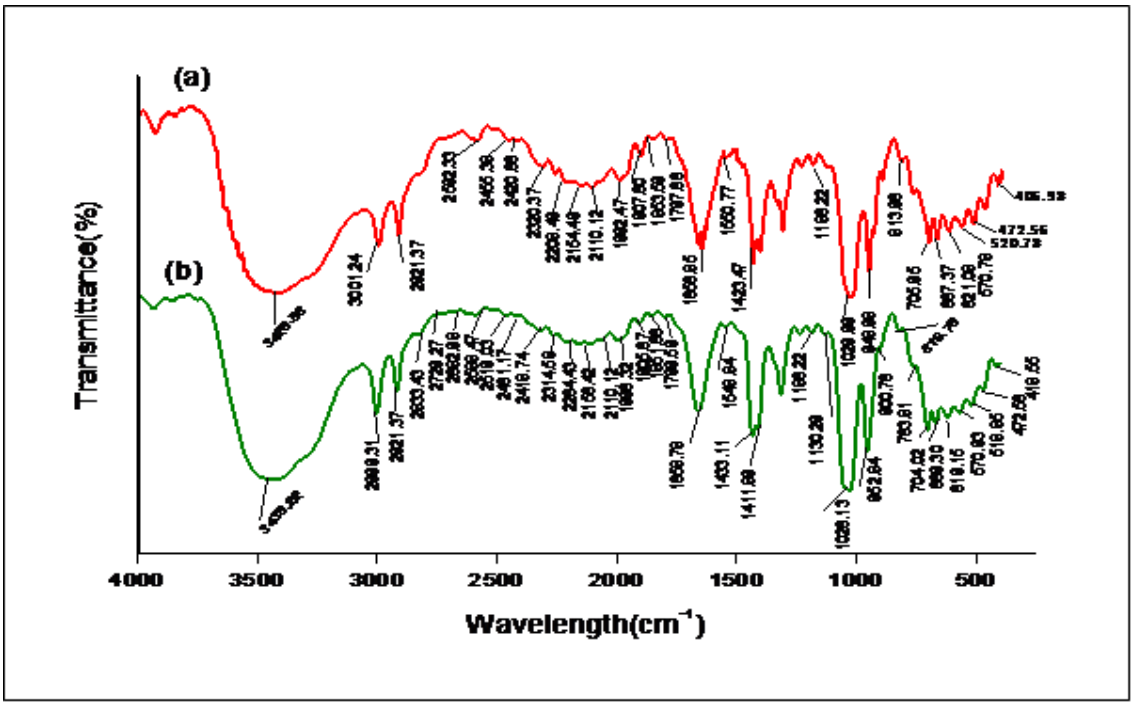


**Fig. 2:** FTIR spectrum of cyclodextrins (a) βCD (b) HβCD

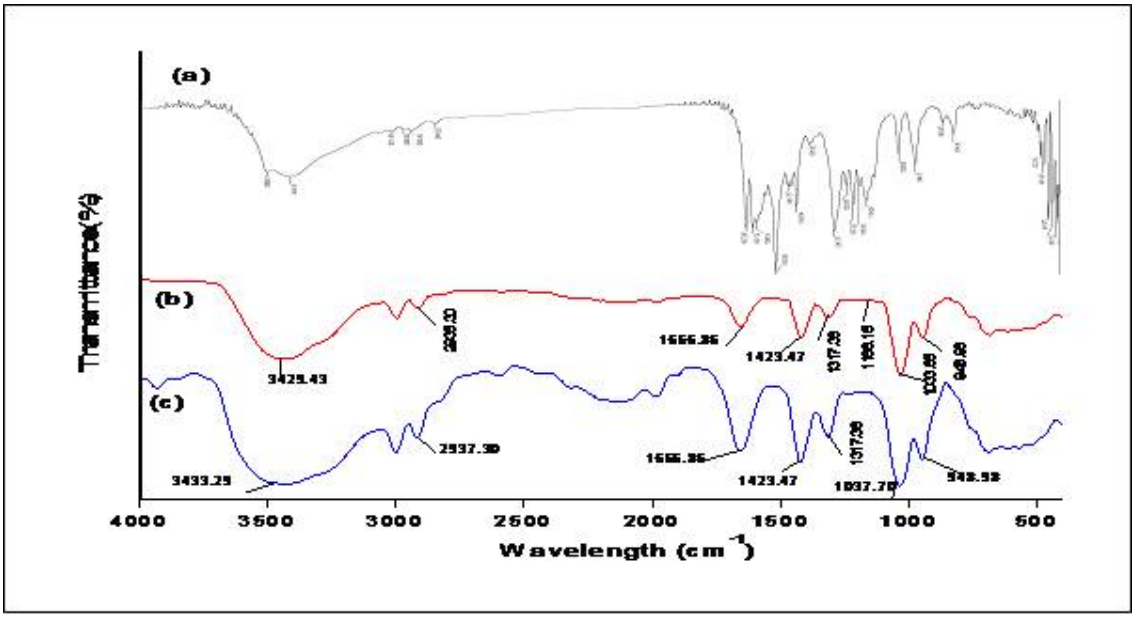


**Fig. 3: FTIR spectrum of curcumin complexes (a) Curcumin, (b) Curcumin+βCD (c) Curcumin+HβCD**

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