



From spice to shield: Curcumin complexes for heavy metal detoxification

V.H.D.Fonseka* and K.R.R. Mahanama

Department of Chemistry, Faculty of Science, University of Colombo

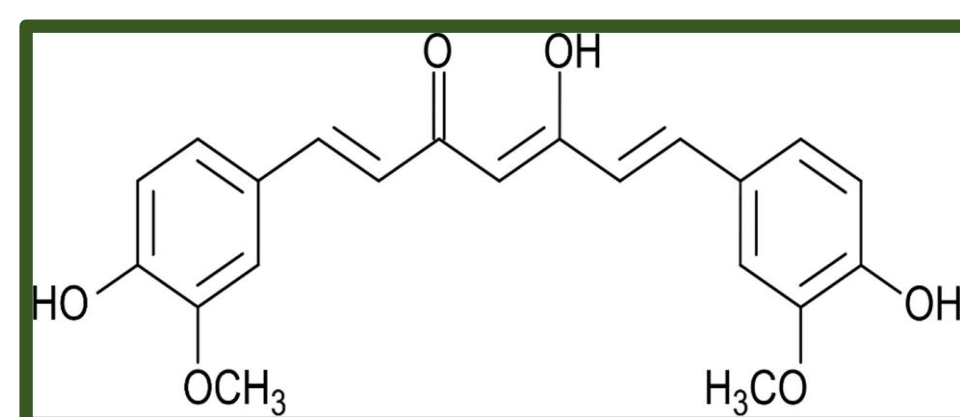
Research Objectives

- To synthesize metal-curcumin complexes and characterize them.
- To minimize dietary exposure to heavy metals by leveraging the chelating capacity of curcumin incorporated in food preparation.

Introduction

Curcumin is a key compound found in turmeric, a spice derived from the rhizome of the perennial herb *Curcuma longa*. The importance of turmeric is attributed to its major phytochemical constituents, known as curcuminoids. There are three chemically related curcuminoids. They are curcumin, demethoxycurcumin (DMC), and bis-demethoxycurcumin (BDMC). Curcumin is mostly used as a metal-chelating ligand, which is its most commonly used ability in this research.

Chemical structure of
Curcumin



Future Work

Further assessment should be done regarding the curcumin-initiated heavy metal complexation, confirming that the formation of metal-curcumin complexes does not introduce new health risks to the human body. Demonstration of in vivo metal-curcumin complex formation is suggested to validate the effectiveness of these metal complex formations in real biological systems.

Methodology

Curcumin was extracted from turmeric rhizomes and purified using column chromatography.



Curcumin Recrystallization and Characterization



Synthesizing metal-curcumin complexes



Characterization of Metal-Curcumin complexes

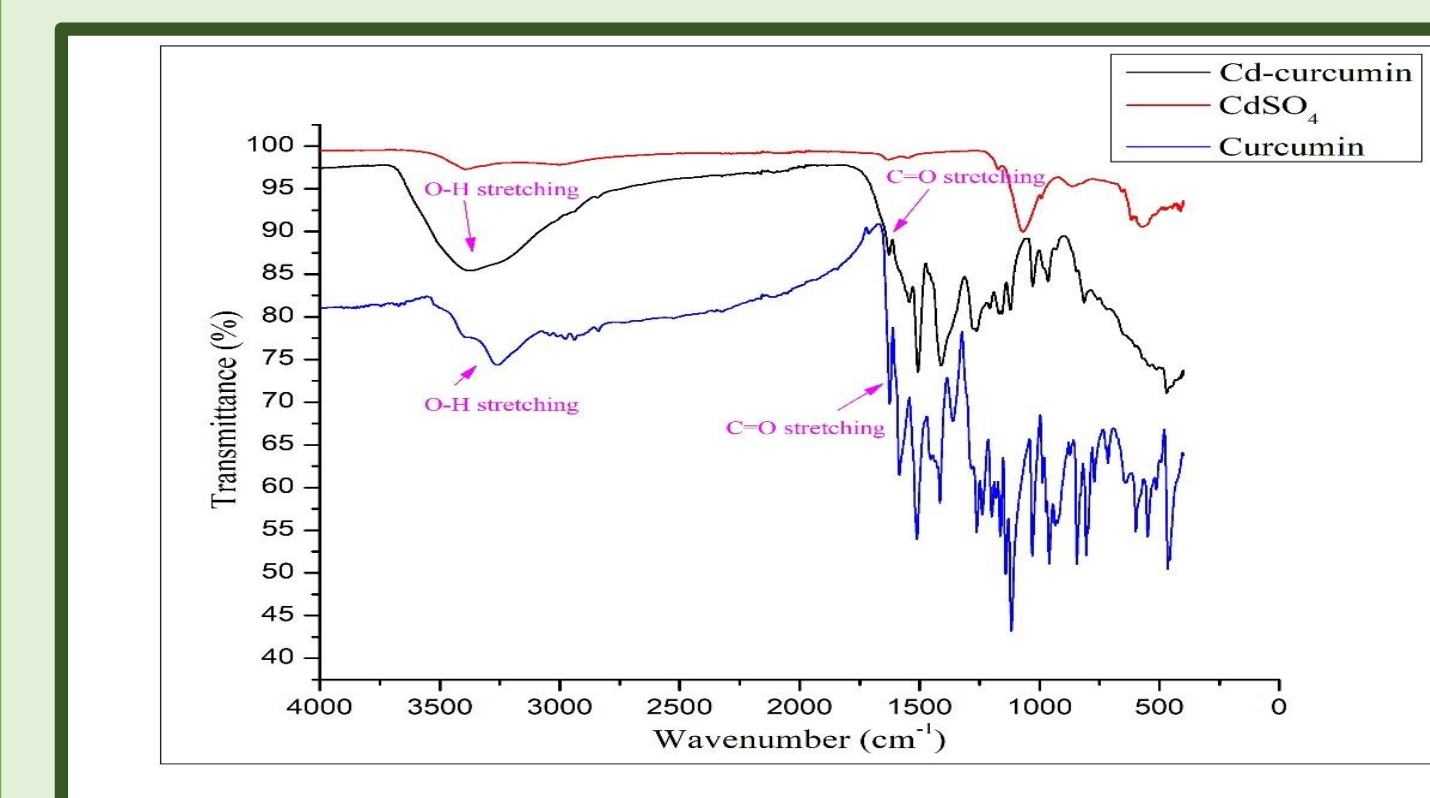
1. Raman Spectroscopy
2. XRD
3. FTIR



Checking the solubility and stability of the synthesized metal-curcumin complexes at physiological conditions.



Determining the ability to form metal-Curcumin complexes, even with a food matrix



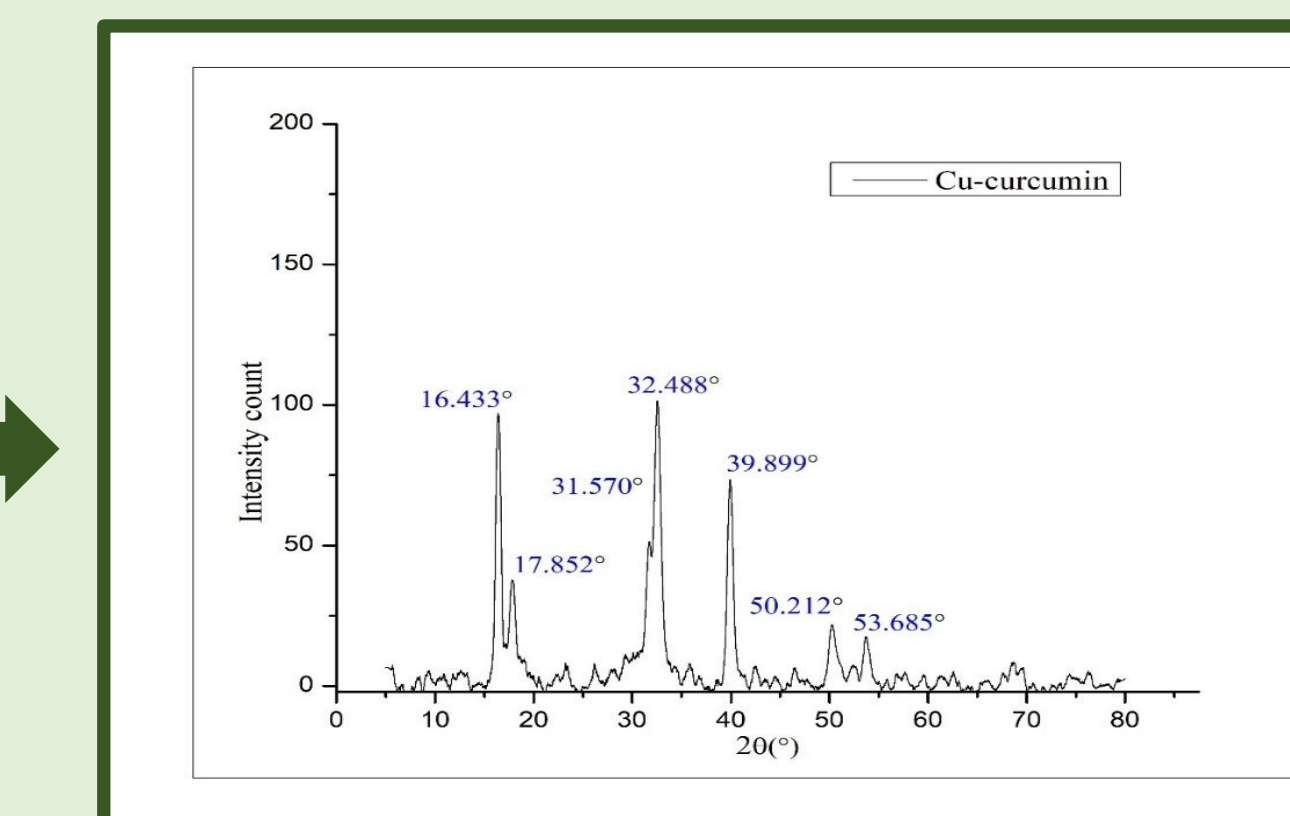
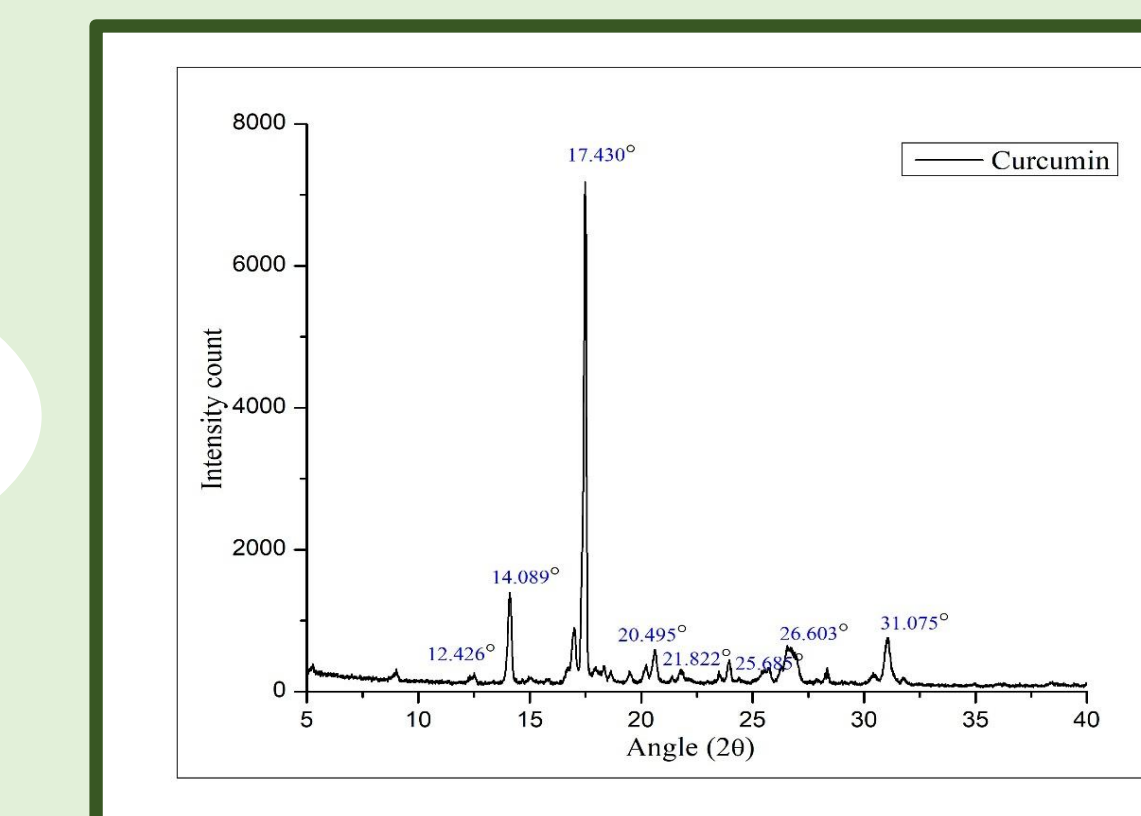
FTIR spectra of Cd-curcumin, CdSO₄ and curcumin

Synthesizing heavy metal-curcumin complexes with a food matrix

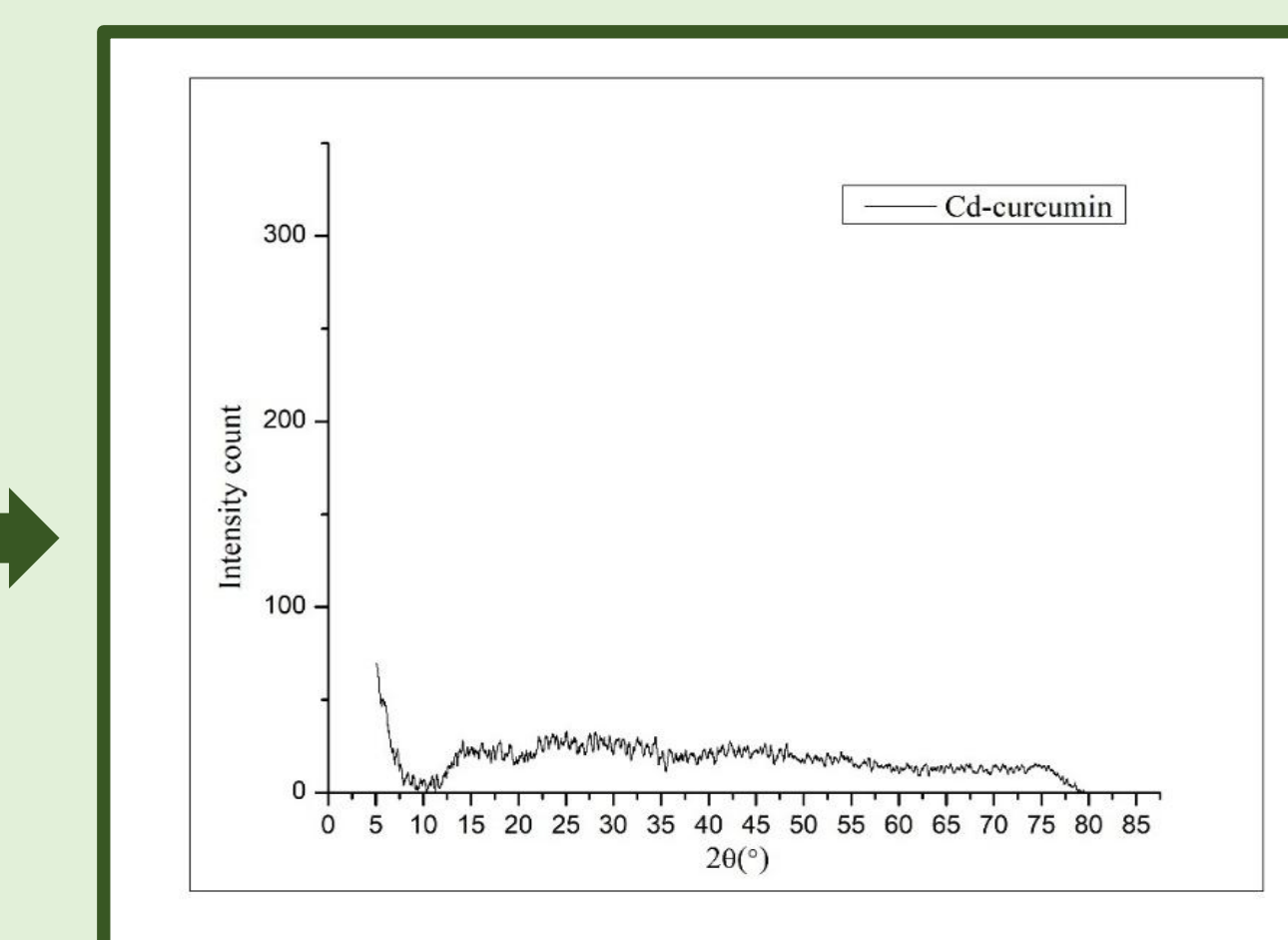
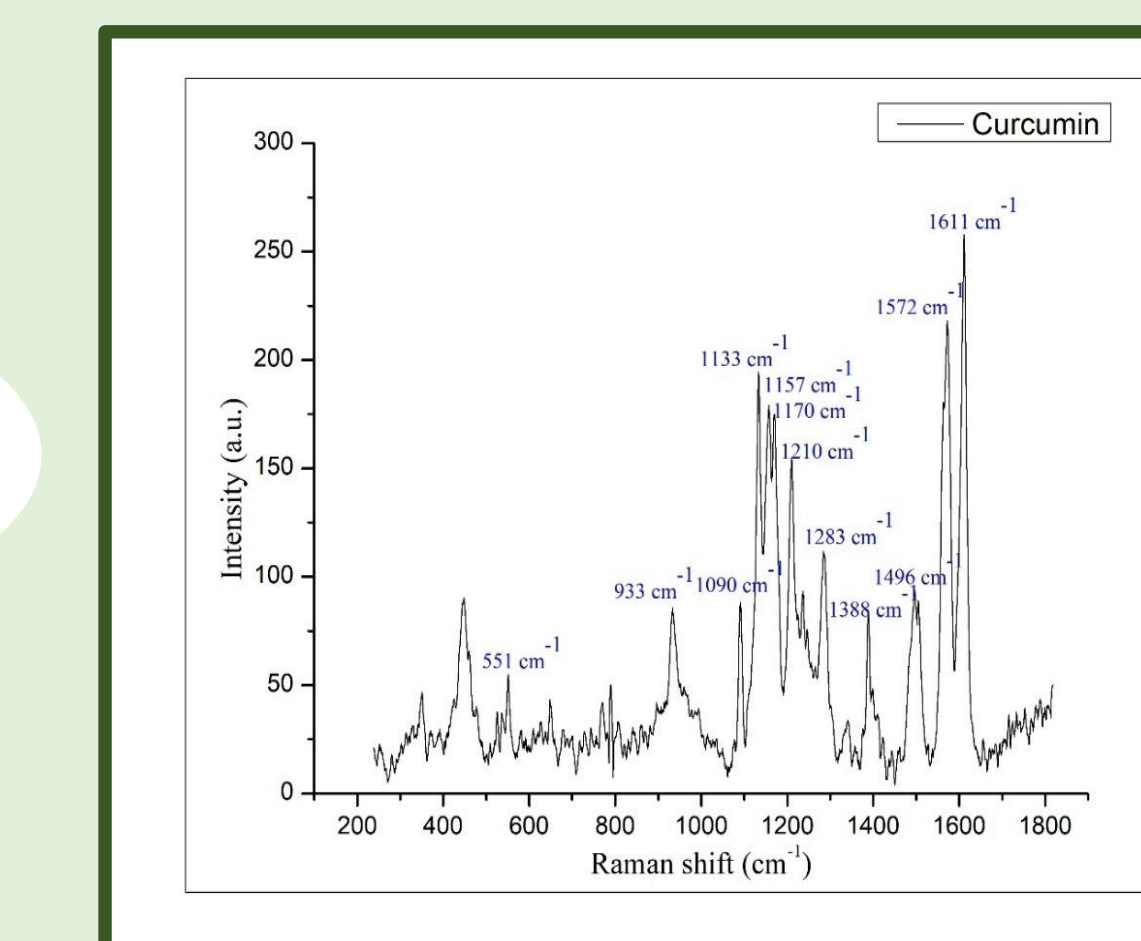
Excess CdSO₄ was added to a food matrix to evaluate Cd-curcumin complex formation. AAS revealed reduced Cd levels, indicating successful complexation even within the food matrix.

Characterization of Metal-Cur Complexes

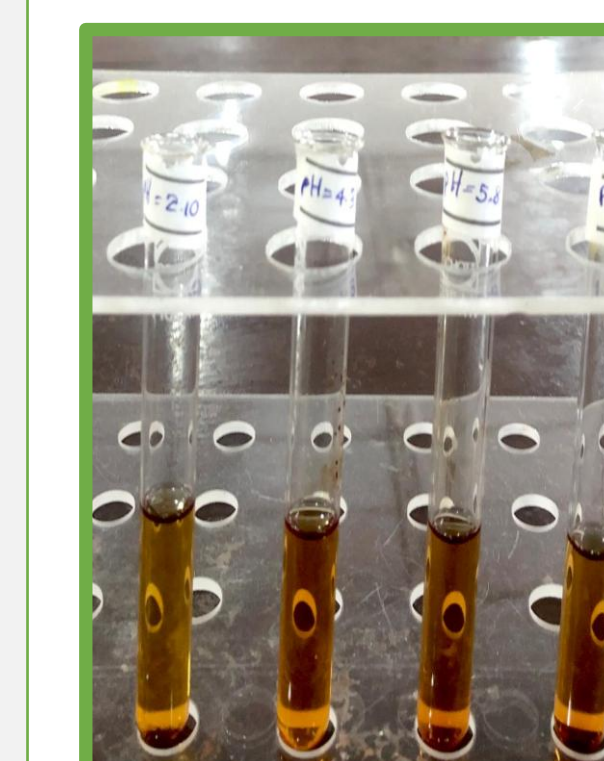
XRD Spectra for curcumin and Cu-cur complex



Raman Spectra for curcumin and Cd-cur complex



Solubility and stability at Physiological conditions



To assess stability under physiological conditions, four pH-adjusted deionized water solutions were prepared. Results showed enhanced water solubility of curcumin complexes compared to curcumin alone.

Cd-curcumin complex in different pH conditions
(A)2.10 (B) 4.30 (C) 5.80 (D) 7.60

Conclusion

Based on these characteristics, metal-curcumin complexes offer a promising approach to reducing health risks associated with heavy metal-contaminated food through chelation during cooking. This study supports human health and well-being by highlighting the effectiveness of metal-curcumin complex formation as a natural strategy for enhancing food safety and mitigating the health hazards from heavy metal exposure.

References

1. Wanninger, Simon, et al. "Metal Complexes of Curcumin – Synthetic Strategies, Structures and Medicinal Applications." Chemical Society Reviews, vol. 44, no. 15, 2015, pp. 4986–5002.
2. Smirnova, Elena, et al. "A Review of the Role of Curcumin in Metal-Induced Toxicity." Antioxidants, vol. 12, no. 2, 21 Jan. 2023, pp. 243–243.