# UNIVERSITI TEKNOLOGI MARA

# ISOLATION, CHARACTERISATION AND SOME BIOLOGICAL ACTIVITIES OF XANTHONES AND ITS METAL COMPLEXES FROM GARCINIA MANGOSTANA

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# ABSTRACT

The investigation of metal complexes has been predominantly centered on coumarin and flavonoid families, successfully producing compounds with diverse biological activities. Xanthones possess electron-rich functional groups and modifiable macrostructure, making them promising starting materials for synthesizing novel compounds. This study explores the under researched potential of naturally occurring xanthones from *Garcinia mangostana* and synthesized metal complexes using these ligands. Coordination complexes were formed with manganese (Mn), iron (Fe), copper (Cu), and palladium (Pd) via a one-pot reaction with a 2:1 molar ratio of ligand to metal. The isolated xanthones were elucidated using Nuclear Magnetic Resonance (NMR), Fourier Transform Infrared Spectroscopy (FTIR) and Ultra-Violet-Visible Spectroscopy (UV-Vis). The structure of the metal complexes was deduced using CUN elemental analysis, FTIR, MS spectroscopy and UV-Vis spectroscopy, thermogravimetry (TGA) and differential scanning calorimetry (DSC). The isolated xanthones and synthesized metal complexes were tested for their antibacterial properties using Minimum Inhibitory Concentrations (MICs) and Minimum Bactericidal Concentration (MBCs) method. While, the cytotoxicity was tested using Sulforhodamine B (SRB) assay against NCI-H460 (human lung cancer cell lines) and MCF-7 (human breast cancer cell lines). Six pure compounds namely a-mangostin **(GM1),** /?-mangostin **(GM2),** l-hydroxy-7-methoxyxanthone **(GM3)** and euxanthone **(GM4),** stigmasterol **(GM5)** and friedelin **(GM6)** were successfully isolated and elucidated from stem barks of *Garcinia mangostana.* A total of eight metal complexes **(Cu-10), (Cu-11), (Cu-20), (Cu-21), (Fe-10), (Fe-11), (Mn-20)** and **(Pd-20)** were synthesized and elucidated. The findings have highlighted that metal complexes exhibit enhanced antibacterial properties compared to their parent ligands. Additionally, the results indicate that these metal complexes show increased cytotoxicity against MCF-7 and NCI-H460 cell lines relative to their ligands. The structure-activity relationship (SAR) analysis has revealed the structural features that are responsible for favourable interactions with specific protein receptors, providing further insight into their biological activities. Overall, the biological studies suggest that metal complexes of xanthone hold promising potential as antibacterial agents and anticancer agents.

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# CHAPTER 1
# INTRODUCTION

## 1.1 Research Background

Chemical compounds known as coordination compounds are made up of core metal atom or ion surrounded by variety of other molecules or ions. The central metal usually comes from transition elements. While, the surrounding atoms, ions and molecules around the central transition metal atom or ion are known as ligands. Ligands act as Lewis bases and donate electron pairs to transition metal atom or ion thus a dative bond is formed between ligands and the transition metal atom or ion. Hence these compounds are also known as coordination compounds or metal complexes (Rafique *et al,* 2010).

A wide range of ligands can be applied in complexation, for example, carboxylate, chlorides, pyridines, water, phosphine, and alkenes. The common donor atoms present in ligands are nitrogen, oxygen and sulphur. Ligands are characterised as monodentate, bidentate, or polydentate according to their ability to donate one, two, or more than two electron pairs. Ligands can be either natural or synthesised. Depending on the number of ligands and the type of central metal atom, their geometries vary (Verma *et al,* 2022). Studies of the literature reveal that many organic and inorganic neutral, cationic, and anionic compounds act as ligands for the production of various coordination complexes that are helpful in biological, industrial and other wide ranges of applications.

The secondary plant metabolites can be the source of the organic ligands. There exist five significant categories of secondary metabolites namely alkaloid, polyphenols, saponins, terpenoids and steroids (Badyal *et al.,* 2020). Among these five secondary metabolites, polyphenols, including flavonoid and coumarin, have received much attention from researchers as potential ligands in the formation of metal complexes. This is because these compounds possess specific functional groups and arrangements in their molecular structures that enable them to chelate with metal ions. Furthermore, they possess a conjugated 7r-electron system that allows for effective electron derealization. This electronic feature contributes to the stability of metal complexes formed with flavonoids and coumarins as ligands.