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| **Thesis Title** | Metal Complexes of Curcuminoids in *Curcuma petiolata* Extract for Cosmetic Emulsions |
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# ABSTRACT

Curcumin has shown a wide range of pharmacological activities including anti-inflammatory, inhibition of bacterial and fungal growth, anti-oxidant activity, inhibition of lipid peroxidation, and anti-tyrosinase activities. However, its application is usually limited due to its insoluble in water, degraded in alkaline solution and unstable to light and heat. Recent studies have demonstrated that the stability and anti-oxidant activity of curcumin would be increased when it is complexed with transition metals. The aims of this study were to determine the ability of three divalent metals, zinc, copper, and magnesium, on enhancing the stability, anti-oxidant and anti-tyrosinase activities of free curcumin. Then the most effective metal will be complex with *C. petiolata* extract and determine its anti-oxidant and anti-tyrosinase activities, stability and whitening effect in emulsion system.

The metal complexes were successfully prepared by refluxing the mixture of curcumin and metal ions in ethanol for 3 hours. The mass spectrometer demonstrated that Cu (II) form mono-ligand complex whereas Zn (II) and Mg (II) form bi-ligand complexes with curcumin. The complexes were also analyzed by UV-Vis, IR, X-Ray powder diffraction, and thermal analysis techniques. The stability of free curcumin

and its metal complexes was investigated by storage at various conditions including pH buffer solution (pH 3, 7 and 12), temperature (25, 37, 45, and 60$^{o}$C), light and dark condition. All buffer solutions, Cu-cur, and Zn-$(cur)_2$ showed higher stability than that of free curcumin. While Mg-$(cur)_2$ complex showed similar degradation behaviors to free curcumin. At all temperature and light exposure conditions, all metal complexes were 2 folds higher stable than that of free curcumin. The results imply that the stability of free curcumin was enhanced by chelation with metals. From the DPPH radical scavenging, ferrous reducing power, and anti-tyrosinase studies, the activities of curcumin was enhanced by complexing with Zn (II) and Mg (II). While Cu-cur showed much lower on anti-oxidant and anti-tyrosinase activities than that of free curcumin. Since Zn (II) can predominant enhance the stability and activity of curcumin. It was chosen to complex with curcumin rich extract from *C. petiolata* rhizomes (CP extract). The complex was characterized by spectroscopic techniques including UV and IR analyses. The anti-oxidant and anti-tyrosinase activities of complex were investigated. Zn-CP complex showed stronger DPPH radical scavenging, ferrous reducing power, and anti-tyrosinase activities than that of CP extract. Four whitening agent (free curcumin, *C. petiolata* extract, Zn-cur, and Zn-CP) were incorporated in o/w emulsion cream. The chemical degradation of active ingredients in various storage conditions was investigated. Metal derivatives showed more stable than free curcumin and CP extract. The products were classified as safe due to no microbial contamination and non irritation on skin. The lightening efficacy study of the product showed the whitening process of application of free form creams, F2 and F3, is complete already after 14 days. While the continued application of metal complexes creams F2 (Zn-$(cur)_2$ and F4 (Zn-CP) showed further lighten the skin..

**Keywords:** *Curcuma petiolata*/Metal-curcumin complexes/Skin whitening