

## Development of the Synthesis of Chromium and Molybdenum – Amino acid Complexes: A Green Chemistry Approach

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**Abstract:** Some concepts of green chemistry were applied on the Synthesis of Chromium(III) and Mo(V) complexes with amino acids. Three concepts were used in this research were changing to safer solvent, using less energy and applying a shorter process. The optimum pH of the complex formation of Chromium (III) is 4, whereas for Mo(V) complex, the most stable condition is at pH=1. The products were characterized by physical properties, Infrared and Uv-Vis spectrophotometer, Atomic Absorption Spectrophotometer, Elemental Analysis, and VSM (Vibrational Sample Magnetometer). The molecular formula of the complexes were predicted by simulation from the composition and the magnetic properties.

### Introduction

Some amino acids complexes with Cr(III) act as a part of GTF (*Glucose Tolerance Factor*), a molecule which involved in the insulin in the processing of glucose into energy. GTF is an oligopeptide composed of glycine, cysteine, aspartate and glutamate with Cr. [1] The interaction of Cr (III) with the insulin is relevant to the case of type 2 diabetes mellitus. Chromium increases insulin binding to cells, insulin receptor number and activates insulin receptor kinase leading to increased insulin sensitivity [2]. Molybdenum has been also reported as a supplement in the diabetic patient [3].

The synthetic product of Cr(III) and Mo(V) complexes with amino acids were needed to provide these product as the antidiabetic supplement. The reported procedures of the synthesis of Chromium (III)-amino acid and Mo (V)-amino acid were complicated and need a long route to get their product. The commonly cited for the synthesis of complexes of Chromium with amino acid ligands is the procedure of Bryan [4]. The synthesis of glycinato complexes need 24 hours reflux process and a month for aging. On the other hand, Wallace [5] reported that the synthesis methods are not reproducible. The other simple method was reported by Yang [6] to prepare Cr-phenylalanine complex by mixing  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  and D-phenylalanine in water. Unfortunately, this procedure also not reproducible in the standard condition.

Most of these reaction were conducted in organic solvent and also need another further steps and aging in a long time [7,8]. Green chemistry concept approach suggest the safer solvent, less energy and shorter process in order to get the appropriate product to this aim. Some modification were applied to develop the synthesis of Cr(III) and Mo(V) complexes with L-glutamic acid, glycine and L-cysteine.

### Material and Methods

#### *a. Materials*

$\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  and  $\text{MoCl}_5$  salt (Sigma Aldrich). Amino acids [L-Glutamic Acid (Glu), Glycine (Gly), and L-cysteine (Cys)] are from E-Merck; Sodium hydroxide (E-Merck).

#### *b. Preparation and Characterization of the Complexes*

$\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  (0.26g, 1mmol) was diluted into 25 ml water and then added by NaOH 0.1M.