

Synthesis and spectral analysis of Quercetin-Transition Metal (II) complexes

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ABSTRACT

Nearly all flavonoids are good metal chelators and can chelate many metal ions to form different complexes. This article describes a synthesis of ligand quercetin–transition metal (II) complexes using methanol as a solvent. The complexes were characterized by using elemental analysis and spectral analysis.

This study showed that the chelation of metal ions by quercetin decrease the redox potential of quercetin-metal complex.

INTRODUCTION

Flavonoids are antioxidants, which are recognized to affect bio-availability of the metal in the body. They have a basic structure of 2-phenyl-benzo- γ -pyrones, frequently polyphenolic in nature. A large number of substitution patterns in the two benzene rings (A and B) of the basic structure occur in nature. Variations in their heterocyclic rings give rise to flavonols, flavones, catechins, flavanones, anthocyanidins and isoflavones¹⁻⁴. Flavonoids, and particularly quercetin derivatives, have received more attention as dietary constituents during the last few years. Experimental studies showed that they have frequent beneficial effects on human health, including cardiovascular protection, anticancer activity, antiulcer effects, and antiallergic, antiviral, and anti-inflammatory properties. These health-promoting activities seem to be related to the natural antioxidant (free-radical scavenging) activity of flavonoids.² Reactive oxygen species (ROS) induce oxidative damage to biomolecules and organelles, and then lead to many diseases like Parkinson's disease, heart disease, and cancer. Researches demonstrated that exogenous antioxidants or free radical scavengers can scavenge the excess free radicals and be benefic to those diseases effectively. Thus, evaluating and developing novel antioxidant is becoming one of the noteworthy topics recently.^{2,5} Most of flavonoids are strong metal chelators which can chelate many metal ions to form different complexes. Those complexes are reported to have various important biological activities, and most of them exhibit higher antioxidant abilities than the ligand flavonoids. However, the antioxidant mechanism of the complexes has not been exactly elucidated so far.^{5,6} The aim of this study, was to prepare Quercetin– transition metal (II) complexes.

MATERIALS AND METHODS

All reagents used for experiments were analytical reagent grade. Extra pure methanol was purchased from Merck. Quercetin was isolated from onion. The standard solutions at 1.00×10^{-3} M concentration of antioxidant compounds were all prepared in 100% MeOH of AR grade. All working solutions of antioxidant compounds were freshly prepared.

SYNTHESIS OF THE COMPLEXES

The synthesis of the Quercetin– transition metal (II) complexes had been carried out according to previous work.⁶ Briefly, in a 50-cm³ two-necked round-bottomed flask equipped with an electromagnetic stirrer and thermometer, quercetin-2H₂O (0.05 g, 0.008 mol) dissolved in MeOH (20 ml) within 15 min, the colour of the solution was light yellow.

Consequently, transition metal (II) salts (0.12 g, 0.016mol) were added quickly in the reaction mixture, now the coloured solutions were obtained and the solutions were stirred at room temperature for 4 h. After stirring, the reaction mixtures were filtered and the filtrates were evaporated slowly at room temperature. The resulting dark coloured product were washed with t-butanol and dried in a vacuum desiccator. A coloured product, Quercetin–transition metal (II) complex, were obtained in good yield^{2,6-8}.

RESULTS AND DISCUSSION

The changes in UV–vis absorption of Quercetin in the presence of transition metal (II) say Ni (II) and Cu (II) were examined in the methanol solution. The UV–vis spectra of Quercetin showed an intense absorbance at 280 and 372 nm. When the solution of transition metal (II) was added, decrease in absorption observed. The results indicated formation of a complex between Quercetin and transition metal (II) ^{1,6,10}.

Complexation of quercetin with transition metal lowers the –OH vibrational frequency 3411 cm^{-1} to 3350 cm^{-1} and 3375 cm^{-1} in Ni (II) and Cu (II) complexes respectively. Further, the vibrational frequency of ketonic group is decreased from 1663.8 cm^{-1} to 1650 – 1630 cm^{-1} indicating the participation of aryl ketonic group in complexation.

CONCLUSION

The complexes of transition metal (II) ion with Quercetin were prepared and characterised by several spectroscopic techniques. Using UV–vis and IR, the coordination to the carbonyl group of the ligand and one of the adjacent hydroxyl groups is assumed. Spectroscopic data suggest that Quercetin molecule can chelate transition metal cations from 3-hydroxy and carbonyl sites. The square planar geometry of the complexes may be shown as in figure given below:

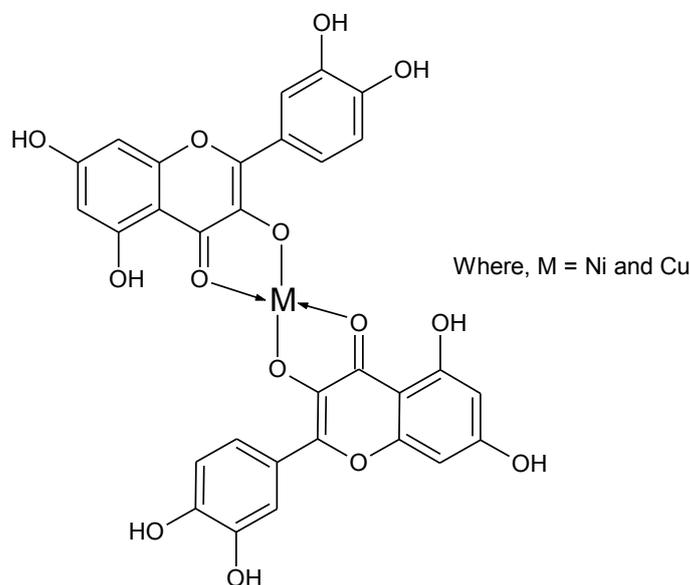


Fig: Structure of the quercetin-metal (II) complex)

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