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Original Article

Synthesis of Schiff base Metal Complexes with Motivating Scavenging Potential Studies

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ABSTRACT

Objective: Schiff's base complexes can be important substitutes for some antioxidant drugs because they have a carbon-nitrogen (N-C) double bond with the ability to push the electrons into the transition metal. **Methods:** A series of Schiff base metal complexes have been synthesized by the condensation of $MCl_2.nH_2O$ (M = Co, Ni, Cu) with 1-(2hydroxybenzylideneamino) quinolin-2(1H)-one. **Results:** The Schiff base and it metal complexes have been characterized by various instrumental techniques like element chemical analysis, molar conductance, magnetic susceptibility measurements and spectral studies. The investigated complexes were subjected to antioxidant studies. The investigated complexes showed an excellent activities as antioxidant as compared to the parent Schiff base and standard compound. **Conclusion:** The data showed that transition metal complexes have significant improved antioxidant activity than Schiff base.

Key words: 2H-chromen-2-one Scavengers, Hydrogen peroxide.

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INTRODUCTION

Schiff bases have a broad applications in various areas like medical chemistry, organic and inorganic chemistry. The medicinal utilization and applications Schiff bases and their metal complexes are of growing clinical and commercial significance. Schiff bases were selected significance in medical and pharmacological domain due to an expansive range of biological activities such as anti-inflammatory,[1,2] analgesic,[3,4] antimicrobial,[5] antispasmodic,[6] tuberculosis,[7] anticancer,[8] antioxidants,[9,10] anthelmintic.[11,12] The antioxidant performance of N-amino quinoline-2-one metal complexes versus, hydrogen peroxide radicals was not described. In our potential on behalf of the development of complexes based therapeutic agents and according to the curative, employment of us and as the duration of previous investigations,[13–20] herein, the spectroscopic characterizations to the prepared complexes of N-aminoquinoline-2-one with 2-hydroxybenzaldehyde was reported. The metal complexes were evaluated for their antioxidant performance. Firstly, we utilized 1-(2hydroxybenzylideneamino) quinolin-2(1H)-one as a ligand (Figure 1) for the preparation of complexes (Figure 2).

MATERIALS AND METHODS

This study was done in the applied science department at the university of technology in Iraq. All chemical used were of reagent grade (supplied by either Merck or Fluka) and used as supplied. Melting points were determined on SMP40 melting point apparatus and were uncorrected. The IR spectra of the compounds were recorded on a shimadzu FT-IR-8300 spectrometer as KBr and CsI disks. The UV spectra were performed on Cintra5-Gbes scientific equipment. Magnetic susceptibility measurement for complexes were obtained at room temperature using (Magnetic susceptibility Balance Model MSB-MKI). Flame atomic absorption of elemental analyzer, shimadzu AA-670 was used for metal determination. Elemental micro analysis, was carried out using C.H.N elemental analyzer model 5500-Carlo Erba instrument.

Synthesis of Schiff base

A mixture of N-aminoquinolone (0.8 g, 0.005 mol) and the (0.005 mol) 2-hydroxybenzaldehyde, was refluxed in absolute ethanol 25 ml for 6-8 h. The reaction mixture was cooled and the product obtained was recrystallized from ethanol, the melting point was 240.

Synthesis of complexes

The salts [$CoCl2.6H_2O$, $NiCl2.6H_2O$ and $CuCl2.2H_2O$] were dissolved in ethanol and added to an ethanolic solution of 1-((2-hydroxybenzylidene)amino)quinolin-2(1H)-one in (2:1) mole ratio ligand to metal respectively, with stirring. The mixture was heated under reflux for three hours, during this period, the precipitation was completed from and collected by

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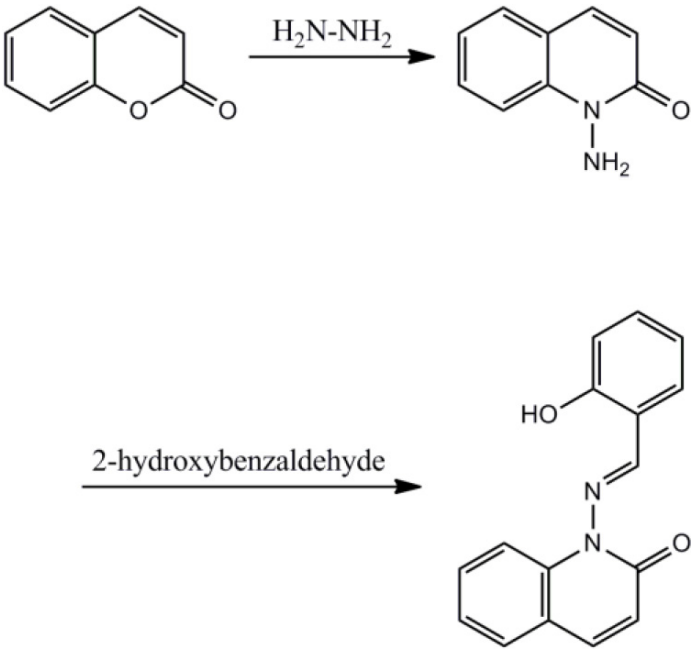

Figure 1: The chemical synthesis of the ligand "1-((2-hydroxybenzylidene) amino) quinolin-2(1H)-one".

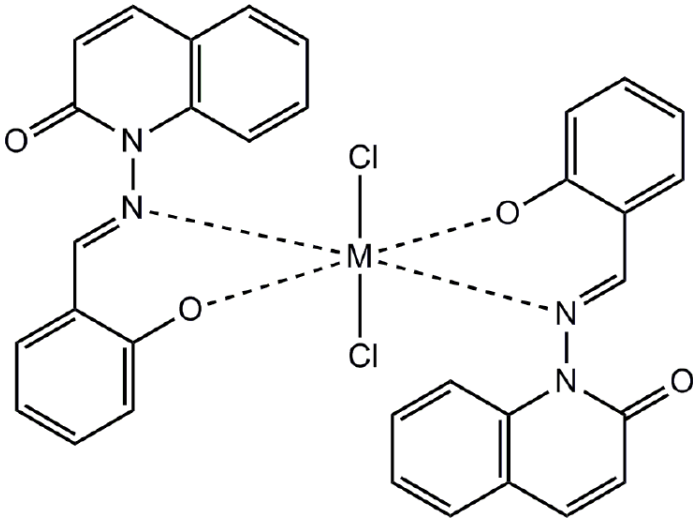

Figure 2: The chemical structures of metal complexes.

Table 1: Physico analytical data for the metal complexes.

Compound	Molar ratio	Colour	Melting point	CHN analysis		
				C (%)	H (%)	N (%)
[Co (L1)2Cl2]	1:2	Light green	202	58.55(56.75)	3.38(4.45)	8.54(10.00)
[Ni(L1)2Cl2	1:2	Yellow	199	58.58(60.65)	3.38(4.33)	8.95(10.21)
[Cu(L1)2Cl2]	1:2	Brown	195	58.15(60.01)	3.35(4.34)	8.48(10.01)

filtration, then washed with ethanol and dried under vacuum for 4 h. All these complexes were analyzed by using different available techniques, the physical proportion of 1-((2-hydroxybenzylidene)amino)quinolin-2(1H)-one and its metal complexes are listed in Table 1.

Study of complexes formation in solution: Complexes of ligands with metal ions were studied in solution using ethanol (or DMF) as solvents, in order to determine (M:L) ratio in the complex following molar ratio method (Sulekh *et al*. 2007).[21] A series of solution were prepared having a constant concentration 10G3 M of metal ion and ligand. The [M/L] ratio was determined from relationship between absorption of the absorbed light and mole ratio of [M/L]. The results of complexes formation in ethanol were listed in Table 1.

Antioxidant activity

H_2O_2 scavenging activity assay

The scavenging activity of 1-((2-hydroxybenzylidene)amino)quinolin-2(1H)-one metal complexes, Compound 1, Compound 2 and Compound 3 has been estimated based on Fenton reaction.[22] Different strengths (250, 500 and 1000 µ/mL) of Compound 1, Compound 2 and Compound 3 Complexes, 0.1mL of 7.5 mM, O-phenanthroline, 0.5 ml of 0.2 M phosphate buffer (pH 6.6), 0.1 mL of 7.5 mM ferrous sulfate and 0.1 mL of H_2O_2 (0.1%) were combined and diluted up to 3 mL with DW (distilled water). Incubation at 30°C for 30 min and the absorbance was evaluated at 510 nm. The hydroxyl radical scavenging activity of complexes and ascorbic acid were estimated using Equation 1.

$$\text{Scavenging activity}\,(\%) = \frac{A_0 - A_1}{A_0} \times 100 \quad (1)$$

where Ao is control absorbance and A1 is the sample absorbance.

Statistical analysis

The data obtained were displayed as the means ± SD, with an analytical significance of the variations, was defined using ANOVA with the SPSS software program. Values were demonstrated meaningful at $P< 0.05$. The significances are displayed as the means ± SD ($n= 3$).

RESULTS AND DISCUSSION

Results

Removing free radicals is the agent of cancer prevention. A substantial importance mechanism to do this target is the hydrogen free radical contribution to transform them into unreactive species.[22-24] The hydrogen radical contribution will remove odd electrons which responsible for reactivity of radical.[25,26] In an earlier decade, free radicals are the most exciting subject, specialists due to influences in biological systems. It had been shown that radicals assume a significant role in aging and specific diseases.[27]

Target complexes were tested for scavenging activity using hydrogen peroxide assay. Complexes demonstrate great scavenging activity (Figure 3).

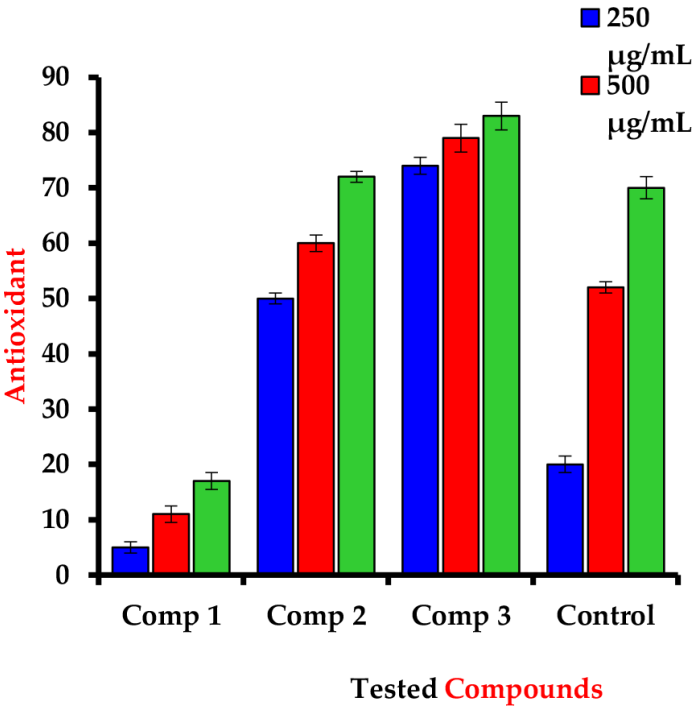

Figure 3: The antioxidant activities of tested complexes and control.

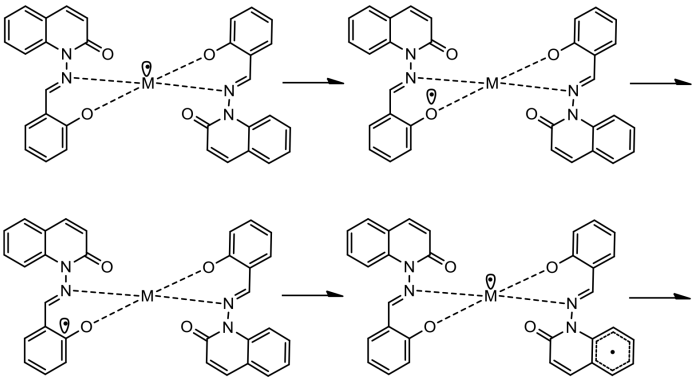

Figure 4: The postulated mechanism for using of metal complexes as antioxidants.

Discussion

Figure 3 demonstrate that the three complexes have the abilities to be perfect scavengers H_2O_2. At a lower concentration of 250 µg/mL we detected a concentration dependent reduction in H_2O_2 activity. Good suppression activities have been displayed for Ni-complex and Co-complex (44.38 ± 1.00 and 42.11 ± 1.50). On the hand, Cu-complex with a high concentration has been shown at 1000 µ/mL as in Figure 3. The perfect scavenging activity was presented by Cu-complex (76.93 ± 1.50). Vitamin C has been utilized as control with an inhibition percentage of 73.85 ± 1.00.

The mechanism for the action of metal complexes as antioxidants, as displayed in Figure 4, depend on the azomethine or imine (–C=N) hydrogen's atoms, which may under the impact of resonance and inductive forces in addition to metal effect. The resonance influence of the azomethine hydrogen's fragments enables the liberation of hydrogen, whereas the inductive influence drives the electrons to an azomethine-free, causing stability of the complexes.

CONCLUSION

The current study involves the preparation of metal complexes as inorganic compounds based on the 1-(2hydroxybenzylideneamino)quinolin-2(1H)-one and then studying the antioxidant effectiveness of these metal complexes versus the hydrogen peroxide.

AUTHOR CONTRIBUTIONS

A.A. was making all of the synthesis and characterization; D.D. was done the antioxidant and statically analysis while the principle investigators A.K. All authors are informed of this paper and have admitted to its publication

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CONFLICT OF INTEREST

The authors have nothing to declare.

ABBREVIATIONS

M: Metal; **UV:** Ultraviolet; **CHN:** Elemental Micro Analysis; **Co:** Cobalt Metal; **Ni**: Nickel Metal; **Cu:** Copper Metal; **H_2O_2:** Hydrogen peroxide; **DW:** distilled water; **pH:** power of hydrogen5.

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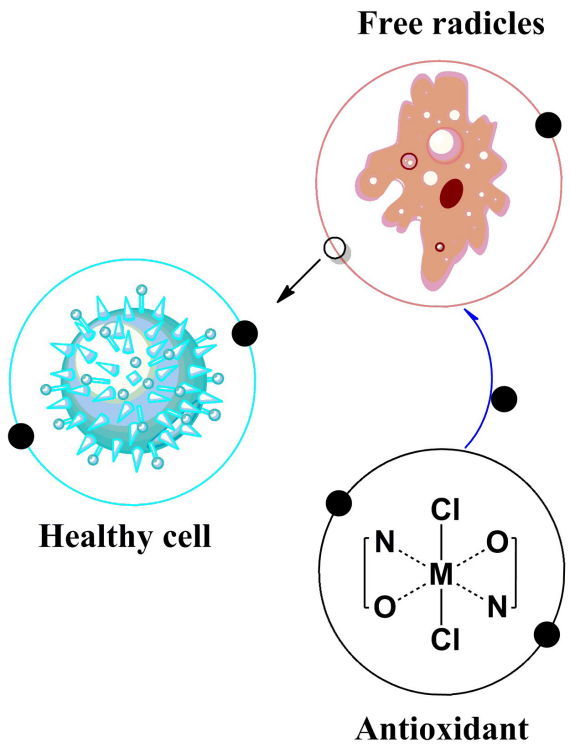
GRAPHICAL ABSTRACT



SUMMARY

- In this study, Schiff base metal complexes were synthesized and characterized by FT-IR and NMR measurements and elemental analysis data. The *in vitro* antioxidant activity of Schiff base metal complexes was evaluated as radical scavengers against hydrogen peroxide. The results showed that all of the synthesized Schiff base metal complexes have good antioxidant potential which might be due to the phenolic group in addition to C=N group introduced after chemical reaction of N-aminoquinolone with 2-hydroxybenzaldehyde.

ABOUT AUTHORS

Ahmed Al-Amiery, is working as Professor of Chemistry Science at University of Technology, with research interests in synthesis of novel applicable molecules, published 150+ peer-reviewed international papers with 16+ patents, awarded the Medal of scientific excellence (2014), and also he holds Science awards from the Ministry of Higher Education and Scientific Research for four consecutive years (2010, 2011, 2012, 2013, 2014, 2015 and 2016), selected for the Who's Who for International Executives 2015, selected for the one of the best mentalities of the world for 2016 by the University of Cambridge and TWAS-Young Affiliates.

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