



## **Bioactive complex compound of Ni(II) with a new Schiff base derived from p-dimethylaminobenzaldehyde and adenosine**

*Florina Ciolan\**

University of Craiova, Faculty of Sciences, Department of Chemistry, Calea București 107 I, Craiova, Romania

---

\* E-mail: [florina\\_ciolan@yahoo.com](mailto:florina_ciolan@yahoo.com)

*Received: 25.10.2024 / Accepted: 02.11.2024 / Published: 20.12.2024*

---

### **Abstract:**

Schiff bases are potentially active compounds which possess anti-inflammatory, analgesic, antifungal, antibacterial, anticonvulsant, antioxidant and cytotoxic activities. These compounds were often used as ligands in coordination chemistry and some of their first-row transition metal complexes exhibited enhanced biological properties. A new bioactive Schiff base derived from p-dimethylaminobenzaldehyde and adenosine and its Ni(II) complex compound have been synthesized and characterized by elemental analysis, IR, UV-Vis spectroscopy as well as from conductometric and magnetic data. The correlation of the results of all these determinations indicated that the new Schiff base acted as bidentate, (N, N)-donor ligand and the Ni(II) compound was a square-planar electrolyte complex of the  $[\text{NiL}_2]\text{X}_2$  type, where  $\text{L} = \text{C}_{19}\text{H}_{22}\text{N}_6\text{O}_4$  and  $\text{X} = \text{Cl}$ .

---

**Keywords:** adenosine Schiff base, square-planar complex, biological activity

## 1. INTRODUCTION

Adenosine is an endogenous nucleoside with potent vasodilator and antiarrhythmic activities. Adenosine also has anti-inflammatory activity and plays an important role in energy transfer as adenosine triphosphate (ATP) and adenosine diphosphate (ADP) [1].

p-Dimethylaminobenzaldehyde has found applications in synthetic, biochemical, biomedical and analytical sciences. The relevance of this compound in microbiology and analytical chemistry has been unparalleled by any other reagent in history. Its ability to form condensation products readily with a wide range of chemical groupings such as amines, carboxylates and other aldehydes will make it more relevant in synthetic design and processes. The biological activity of Schiff bases derived from p-dimethylaminobenzaldehyde and the appropriate aromatic primary amines, anthranilic acid or p-aminosalicylic acid, as well as their bioactive coordination compounds have been reported [2].

A systematic study of the preparation, isolation and reactions of adenosine Schiff bases has been reported [3].

With this envision in the mind, a new biologically active Schiff base ligand derived from p-dimethylaminobenzaldehyde and adenosine and its coordination compound of Ni(II) were synthesized. The results of this study indicated that the new Schiff base acted as bidentate, (N, N)-donor ligand and the potentially bioactive Ni(II) compound was a square-planar electrolyte complex of the  $[\text{NiL}_2]\text{X}_2$  type, where  $\text{L} = \text{C}_{19}\text{H}_{22}\text{N}_6\text{O}_4$  and  $\text{X} = \text{Cl}$ .

## 2. MATERIALS AND METHODS

All the chemicals used were of analytical reagent grade and were obtained from Merck. They included p-dimethylaminobenzaldehyde, adenosine, absolute ethanol, dimethylsulfoxide (DMSO) as solvents and the metal (II) salt,  $\text{NiCl}_2 \cdot 6\text{H}_2\text{O}$ .

### *Preparation of the Schiff base:*

Equimolar amounts of adenosine and p-dimethylaminobenzaldehyde were dissolved in hot absolute ethanol. The solution was refluxed for 1h and then left overnight at room temperature. The formed solid yellow orange product was filtered and washed with absolute ethanol. It was dried at room temperature over anhydrous  $\text{CaCl}_2$  in a desiccator and recrystallized from hot absolute ethanol to give the new Schiff base.

### *Synthesis of the nickel complex:*

The Ni(II) complex compound was prepared by adding a solution of new Schiff base in absolute ethanol to a solution of metal salt. The reaction mixture was stirred under reflux for 2h and left standing overnight at room temperature. The obtained coloured product was separated by filtration, washed with distilled water, ethanol and dried at room temperature over anhydrous CaCl<sub>2</sub> in a desiccator.

These new synthesized compounds were characterized by elemental analysis, IR, UV-Vis spectroscopy as well as from conductometric and magnetic data.

## **3. RESULTS AND DISCUSSION**

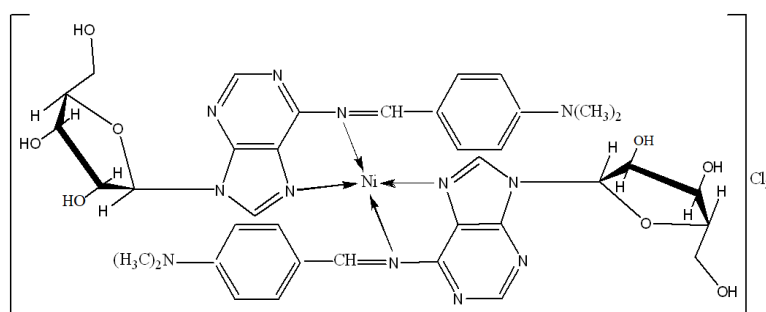
The light green complex compound of nickel (II) was obtained by refluxing of the ethanolic solution of the Schiff base with the Ni(II) chloride, in a ligand to metal molar ratio 2 : 1. The molar conductance value, 175 Ω<sup>-1</sup>·cm<sup>2</sup>·mol<sup>-1</sup>, indicated the 1 : 2 electrolytic nature [4] of this complex compound, which are of the [NiL<sub>2</sub>]X<sub>2</sub> type, where L = C<sub>19</sub>H<sub>22</sub>N<sub>6</sub>O<sub>4</sub> and X = Cl.

The IR spectrum of the Schiff base ligand showed a strong band at 1610 cm<sup>-1</sup> which may be assigned to C=N<sup>6</sup> stretching vibration. This band shifted at 1603 in the IR spectrum of the Ni(II) complex, which suggested the involvement of the azomethine nitrogen atom in coordination to the metal ion [5]. In the IR spectrum of the Schiff base ligand, a very strong band at 1300 cm<sup>-1</sup> was due to ν(C-N) and ν(C=N) of the imidazole ring from adenosine moiety (higher contribution of the C<sup>8</sup>=N<sup>7</sup> vibration) [6]. This band is shifted to lower frequencies in the IR spectrum of the Ni(II) complex, indicating the participation of the N<sup>7</sup> atom from imidazole ring of adenosine moiety in coordination. The spectrum of nickel complex also showed a weak band at 425 cm<sup>-1</sup> corresponding to ν(Ni-N) stretching vibration, which supported the involvement of indicated nitrogen atoms in coordination to the metal ion. Therefore, from the IR spectra, it was concluded that the Schiff base ligand binded to the metal ion through the azomethine nitrogen atom N<sup>6</sup> and the N<sup>7</sup> atom from imidazole ring of adenosine moiety.

The UV-Vis spectrum of Ni(II) complex exhibited a strong absorption band at 427 nm ( $23400\text{ cm}^{-1}$ ) due to the  ${}^1A_{1g} \rightarrow {}^1A_{2g} (v_2)$  transition and a second more intense band at 370 nm ( $27030\text{ cm}^{-1}$ ) ( $v_3$ ) assigned to the  ${}^1A_{1g} \rightarrow {}^1B_{1g}$  transition; these transitions are characteristic to  $\text{Ni}^{2+} (d^8)$  ion present in a square planar configuration [7]. This structure was further confirmed by the value of the magnetic moment for this complex compound.

Elemental analysis results were in good agreement with the proposed composition of the studied compounds.

On the basis of all these results, the proposed structure for the nickel complex compound is presented in Figure 1.



**Figure 1.** The proposed structure for the Ni(II) complex compound

#### 4. CONCLUSION

In this study, a new Schiff base (L) and its potentially bioactive complex compound with nickel (II) ion have been synthesized and characterized by various physico-chemical methods. The correlation of the elemental chemical analysis with the results of the physico-chemical determinations suggested that the Ni(II) complex compound was of the  $[\text{NiL}_2]\text{X}_2$  type, where  $\text{L} = \text{C}_{19}\text{H}_{22}\text{N}_6\text{O}_4$  and  $\text{X} = \text{Cl}$ . From the IR spectra, it is concluded that Schiff base ligand acted as bidentate, (N, N)-donor ligand. The electronic spectra indicated a square planar geometry for the complex compound of Ni(II) and the magnetic data confirmed this proposed stereochemistry.

## REFERENCES

- [1] S. A. Hutchinson and P. J. Scammells, *Current Pharmaceutical Design*, 10 (2004) 2021.
- [2] F. Ciolan, L. S. Sbirna, A. Reiss, *Annals of the University of Craiova, The Chemistry Series*, XLI (2012) 20.
- [3] E. W. Badger, D. S. Szotek, W. H. Moos, *Nucleosides & Nucleotides*, 5 (1986) 201.
- [4] W. J. Geary, *Coord. Chem. Rev.*, 7 (1971) 81.
- [5] F. Ciolan, L. Patron, L. Marutescu, M. C. Chifiriuc, *Farmacia*, 63 (2015) 86.
- [6] R. Sankar, T. M. Sharmila, *Results in Chemistry*, 6 (2023) 101179.
- [7] A. B. P. Lever, *Inorganic Electronic Spectroscopy*, Elsevier Publishing Company, Amsterdam (1968).