

The Multifarious Pendant-Arms in Macrocylic Metal Complexes and their Bioactivity toward CT-DNA



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Abstract

In recent years, more and more dicompartmental tetraazadiphenol macrocyclic ligands and their polynuclear complexes of type have been synthesized and determined by X-ray diffractions single crystal structure analysis. The results customary revealed a monoclinic or triclinic crystal system even in the case of multifarious functionalized pendant-arms. With a point of view to investigate their special chemical and physicochemical properties, the binding activity toward calf thymus deoxyribonucleic acid (CT-DNA), the hydrolysis of 4-nitrophenyl phosphate disodium salt hexahydrate (pNPP) and antibacterial activity were discussed, and proven to be potential DNA cleavage agents and potent inhibitors against the bacterial.

Keywords: Macrocylic complexes; DNA cleavage agents; Potent inhibitors

Abbreviations: CT-DNA: Calf Thymus Deoxyribonucleic Acid; pNPP: 4-Nitrophenyl Phosphate Disodium Salt Hexahydrate

Introduction

Amounts of researches have been done on the preparation of dicompartmental tetraazadiphenol macrocyclic complexes (DTMC) due to their antibacterial, catalysis, magnetism and other biological properties [1-3]. Some of DTMC with pendant-arms are the condensation products of 2,6-dimethyl-4-X-phenol and α , ω -amine, using a template-directed synthesis method, addition of the acetate of transition metals followed by sodium perchlorate hexahydrate are the good choices in this process [1-4]. The formation of crystals times vary from a week to months, and colors maybe orange, green or yellow. The crystal structures of the synthesized robson macrocycles customary revealed a monoclinic or triclinic crystal system. The two metal (usually transition metal) ions settled down in the suitable cavities and coordinated with $(N_{amine})_2O_2$ and/or $(N_{imine})_2O_2$ sites, the geometry around each metal center can be approximately described as a distorted pyramidal with a structural index parameter τ range from 0 to 1 frequently.

DTMC with pyridylmethyl pendant-arms, 2-thiophenoethyl pendant-arms, and benzyl pendant-arms have been found [3-5]. DNA binding is the critical step for DNA cleavage in most cases. To establish correlations between the binding structures and the

reactivity toward DNA cleavage, spectroscopic and voltammetric methods were employed [6-7]. There are three kinds of interactions between complexes and DNA:

- i. Intercalation between base pairs of DNA and the aromatic groups in the complexes through p-p stacking,
- ii. Hydrogen bonding and Vander Waals interactions along the groove,
- iii. Coordination and oxidation on the outside of the DNA helix [8].

In UV-Visible spectra, hyperchromicity or hypochromicity together with red or blue shift would indicated the interactions firstly, the further intrinsic binding constant (K_b) was given by the ratio of slope to intercept in the plot of $[DNA]/(\epsilon_a - \epsilon_b)$ vs. $[DNA]$ using the data from the absorbance titrations. They combine each other to determine the binding ability [9-10].

Conclusion

DTMC bearing conjugate pendant-arms have been designed and prepared to investigate their structural factors on the DNA cleavage activities for obtaining better DNA cleavage agents. They

can provide additional donors, enhance stability of complexes and firmly fix on double helical DNA than the mother DTMC, the corresponding K_b are higher. Besides, the typed complexes can be used as metallohydrolases to rapid hydrolysis of inert biological macromolecules such as nucleic acids and protein under mild conditions. More pendant-arms macrocyclic metal complexes may be explored and became the bioactive metal based drugs in the further.

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References

1. Kou H Z, Wang Y, Ding P P, Cheng X Z, Zhou G Q (2020) Synthesis, crystal structure, phosphate hydrolysis activity and antibacterial activity of macrocyclic dinuclear Zn(II) complex with benzyl pendant-arms. *J Mol Struct* 1216: 128299.
2. Chen Y F, Song H T, Mao J W, Liu M, Ding C, Pan Z Q (2013) Design and synthesis of two macrocyclic dinuclear copper (II) complexes with reversible binding of nitric oxide. *Inorg Chem Commun* 27: 131-137.
3. Pan Z Q, Ding K, Zhou H, Cheng Q R, Chen Y F, Huang Q M (2011) Syntheses, structures and properties of dinickel(II) macrocyclic complexes with two 2-thiophenoethyl pendant arms. *Polyhedron* 30: 2268-2274.
4. Cheng Q R, Chen J Z, Zhou H, Pan Z Q (2011) Syntheses, crystal structures, and properties of two macrocyclic dinuclear Ni(II) complexes bearing 2-pyridylmethyl pendant-arms. *J Coord Chem* 64: 1139-1152.
5. Ding P P, Wang Y, Kou H Z, Li J F, Shi B X (2019) Synthesis of heterobinuclear Cu(II)-Ni(II) complex: Structure, CT-DNA interaction, hydrolytic function and antibacterial studies. *J Molecular Structure* 1196: 836-843.
6. Li N, Ma Y, Yang C, Guo L P, Yang X R (2005) Interaction of anticancer drug mitoxantrone with DNA analyzed by electrochemical and spectroscopic methods. *Biophys. Chem* 116(3): 199-205.
7. Iqbal M, Karim A, Ullah I, Haleem M A, Ali S, et al. (2021) Synthesis, characterization, structural description, TGA, micellization behavior, DNA-binding and antioxidant activity of mono-, di- and tri-nuclear Cu(II) and Zn(II) carboxylate complexes. *J Coord Chem* 74: 762-778.
8. Pyle A M, Rehmann J P, Meshoyrer R, Kumar C V, Turro N J, et al. (1989) Mixed-ligand complexes of ruthenium (II): factors governing binding to DNA. *J Am Chem Soc* 111: 3051-3058.
9. Senthil Kumar R, Arunachalam S (2007) DNA binding and antimicrobial studies of some polyethyleneimine-copper (II) complex samples containing 1,10-phenanthroline and L-tyrosine as co-ligands. *Polyhedron* 26: 3255-3262.
10. Wu H L, Jia Fei, Kou F, Liu B, Yuan J K, et al. (2011) A Schiff base ligand N-(2-hydroxyacetophenone)-3-oxapentane-1,5-diamine and its nickel(II) complex: synthesis, crystal structure, antioxidation, and DNA-binding properties. *Transit Met Chem* 36: 847-853.



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