Study of the photostability and degradation kinetics of the nitric oxide acceptor complex

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Abstract

The potential application of ruthenium complexes as metallodrugs[1], such as anticancer, anti-inflammatory, and antiseptic agents, has generated significant interest in this class of compounds due to their potential in the field of healthcare, whether producing or scavenging nitric oxide (NO)[2] in the reaction medium through reduction or photochemical pathways[2,3]. In the present study, photostability studies were conducted to observe the behavior of a model complex [Ru(H_2O)Hedta] (Figure 1) when exposed to light since recent studies have shown that ruthenium complexes can undergo redox reactions due to the influence of pH, temperature, and exposure to light. Furthermore, these compounds meet most of the necessary requirements for effective NO scavengers in biological systems[3]. The ethylenediaminetetraacetato complex was found to be pentadentate in aqueous solution, with the sixth coordination site occupied by a water molecule or a hydroxide ion. In aqueous solution, the complex can exist in three forms: [RuIII(Hedta)H_2O], [RuIII(edta)H_2O], and [RuIII(edta)OH], depending on the pH[4,5]. Photodegradation assays were performed by irradiating the complex solution with a 16-mW laser. Photodegradation was monitored spectrophotometrically at 393 nm (Figure 2), showing a second-order polynomial decay. The degradation rate of the complex follows the kinetics model described by Hixson-Crowell, with a rate constant of 8.76×10^{-2} min^{-1}. This indicates that, in solution, the compound should be kept away from light.

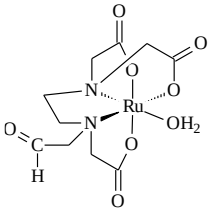


Figure 1: Molecular structure of the complex [Ru(H_2O)HEDTA].

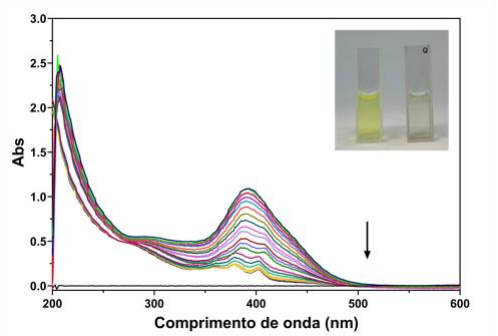


Figure 2: Photodegradation of the compound [Ru(III)(Hedta)H_2O] induced by a 370 nm laser source and monitored spectrophotometrically.

Recent Publications (minimum 5)

1. Lu, Y., Zhu, D., Gui, L. et al. A dual-targeting ruthenium nanodrug that inhibits primary tumor growth and lung metastasis via the PARP/ATM pathway. J Nanobiotechnol 19, 115 (2021).
2. Castellarin A, Zorzet S, Bergamo A, Sava G. Pharmacological Activities of Ruthenium Complexes Related to Their NO Scavenging Properties. International Journal of Molecular Sciences. 2016; 17(8):1254.
3. Morbidelli, L., Donnini, S., Filippi, S. et al. Antiangiogenic properties of selected ruthenium(III) complexes that are nitric oxide scavengers. Br J Cancer 88, 1484–1491 (2003).
4. Lahiri GK, Kaim W. Electronic structure alternatives in nitrosylruthenium complexes. Dalton Trans. 2010.
5. Chatterjee D, Chrzanowska M, Katafias A, van Eldik R. Reaction mechanisms relevant to the formation and utilization of [Ru(edta)(NO)] complexes in aqueous media. J Inorg Biochem. 2021.

Photograph



Biography

Dr Anderson de Jesus Gomes is an Associate Professor at the University of Brasilia. He earned his bachelor's degree in chemistry in 1995 from the Federal University of Uberlandia, Brazil. Gomes completed his master's and Ph.D. in Chemistry at the University of São Paulo, Brazil, in 1998 and 2003, respectively. The scientist conducted three post-doctoral internships in different areas, including the evaluation of psoralen on tumor cells, the synthesis of metallic complexes, and the encapsulation of these compounds in various matrices for tumor cell studies. Between 2013 and 2014, he worked as a visiting professor in the Department of Biomedical Engineering at Columbia University, USA, where he conducted research on theranostic systems to track drug biodistribution. He currently leads projects focused on the production and optimization of nanostructured drug systems, the development of theranostics, the synthesis of bioinorganic molecules, and the study of the photodegradation of drugs and environmental waste.

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Notes/Comments: