XXI Brazilian Meeting on Inorganic Chemistry
X Brazilian Meeting on Rare Earths
III Workshop on Theoretical Bioinorganic Chemistry
Belo Horizonte, September 12 - 15th 2024

Cu_2O nanoparticles as precursors for the increase of reactive oxygen species in tumor cells

Fernanda Pinto dos Santos[1], Francisco Rinaldi[2] and Roberto Santana da Silva[3]

[1]*Faculdade de Ciências Farmacêuticas, Universidade de São Paulo, Ribeirão Preto, Brazil*
[2]*Faculdade de Ciências Farmacêuticas, Universidade de São Paulo, Ribeirão Preto, Brazil*
[3]*Faculdade de Ciências Farmacêuticas, Universidade de São Paulo, Ribeirão Preto, Brazil*
E-mail: fernandapdosantoss@usp.br

Thematic Area: Photochemistry

Keywords: Photodynamic therapy, nanoparticles, tumor cells

The development of innovative strategies to improve the efficacy of cancer treatment is a critical area of research. Nanoparticles have emerged as promising tools for targeted therapy, with the potential to enhance the outcomes of Photodynamic Therapy (PDT) by increasing the generation of reactive oxygen species in tumor cells. In this study, we propose the use of Cu_2O nanoparticles (CuNP) as catalysts to elevate the levels of reactive oxygen species (ROS) in the tumor microenvironment, coupled with ruthenium-phthalocyanines to enhance the effectiveness of PDT [1]. The CuNP was synthesized by conjugation with polyvinilpyridine (PVP) producing Cu_2O-PVP with diameter around 150 nm, based on measurement Particle Size Analyzer. Functionalization with ruthenium-phthalocyanine derivatives – [Ru(Pc)] - will provide singlet oxygen production by light irradiation at 660 nm [2]. The [Ru(Pc)] complexes are cytotoxic against tumor cells as observed in Table 1. It seems to be dependent on the $^1O_2$ production. In this regard, a series of recent studies have elegantly shown the production of hydrogen peroxide by cancer cells, which could be used to increase the oxygen concentration and consequently $^1O_2$. Based on this, the generation of oxygen was tested using the CuNP with hydrogen peroxide using O_2 sensor (Figure 1). Next, cytotoxicity studies will be performed to assess the cytotoxicity of the complexes in a variety of tumor and non-tumor cell lines, evaluate cellular uptake, and elucidate the mechanism of action associated with PDT. This approach aims to exploit the unique properties of the nanoparticles and ruthenium complexes to selectively target and eliminate cancer cells under light irradiation, potentially overcoming resistance mechanisms and improving treatment outcomes. This research project represents a promising approach in the field of nanotechnology applied to oncology, with the potential to revolutionize cancer therapy.

A

	IC_{50} (μM) ± DP 4 h - 6 J.cm^{-2}
Complex	MDA-MB-231
Trans-[Ru(No)(Pc)(NO_2)]	4,32 ± 0,30
Trans-[RuCl(DMSO)(Pc)]	4,51 ± 1,86

	IC_{50} (μM) ± DP 4 h - Dark
Complex	MDA-MB-231
Trans-[Ru(No)(Pc)(NO_2)]	9,54 ± 0,54
Trans-[RuCl(DMSO)(Pc)]	> 32

Table 1: Cell viability results originated of [Ru(Pc)] derivative compounds in tumor cells

B

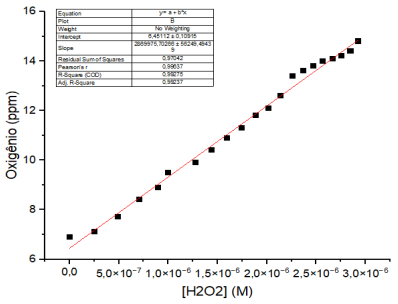

Figure 1: Oxygen measurement as catalitic process dependent on CuNP
$H_2O_2 + CuNP \rightarrow O_2 + H_2O$

Acknowledgments: CNPq and Fapesp

References

[1] T. Lin, X. Zhao, S. Zhao, H. Yu, W. Cao, W. Chen, H. Wei. H. Guo. Theranostics 8 (2018) 990-1004

[2] KOSTOVA, I. Current Medicinal Chemistry, 2006.