# Study of the Anticancer Activity of Polyoxometalates

J. M. Parris[1]

[1]University of Zürich

Polyoxometalates (POM) are polynuclear transition metal oxo-clusters, commonly composed of $V^{5+}$, $Nb^{5+}$, $Ta^{5+}$, $Mo^{6+}$, and $W^{6+}$, making up a class of coordination complexes that can take on a broad range of compositions and structures.[1,2] They have previously proven themselves as suitable drug candidates against cancers;[3-7] their suitability arises from the modularity of their structure and tunability of their properties.[5,7]

Despite the growing field of research on the anticancer activity of POMs, the mechanisms leading to the POMs' cytotoxicity are not well understood,[4] nor are the stability of the POMs in the cellular environment,[8] and therefore the active species leading to the therapeutic effects are unknown.[4]

With this work, these shortcomings aim to be addressed. The stability and speciation of various, common POMs in aqueous solution and cell culture medium have been investigated by NMR. Then the effects of the POM species and relevant reference compounds on different cell lines were investigated using PrestoBlue assays. In this way, the features of the POMs' structures causing the anti-cancer activity can be derived and an effective and selective POM-drug candidate can be developed.

1. Pope, M. T. *Heteropoly and Isopoly Oxometalates*, Vol. 8; Springer-Verlag, 1983.
2. Pope, M. T.; Müller, A. Polyoxometalate Chemistry: An Old Field with New Dimensions in Several Disciplines. *Angew. Chem. Int. Ed. Engl.* **1991**, *30* (1), 34–48. DOI: 10.1002/anie.199100341.
3. Liu, Y.; Tian, S.; Liu, S.; Wang, E. In vitro inhibitory effect of polyoxometalates on human tumor cells. *Transition Met. Chem.* **2005**, *30* (1), 113–117. DOI: 10.1007/s11243-004-3825-1.
4. Bijelic, A.; Aureliano, M.; Rompel, A. Polyoxometalates as Potential Next-Generation Metallodrugs in the Combat Against Cancer. *Angewandte Chemie (International ed. in English)* **2019**, *58* (10), 2980–2999. DOI: 10.1002/anie.201803868. Published Online: Oct. 12, 2018.
5. Čolović, M. B.; Lacković, M.; Lalatović, J.; Mougharbel, A. S.; Kortz, U.; Krstić, D. Z. Polyoxometalates in Biomedicine: Update and Overview. *Current medicinal chemistry* **2020**, *27* (3), 362–379. DOI: 10.2174/0929867326666190827153532.
6. Mukherjee, H. N. Treatment of Cancer of the Intestinal Tract with a Complex Compound of Phosphotungstic Phosphomolybdic Acids and Caffeine. *J. Indian Med. Assoc* **1965**, *44*, 477–479.
7. Hill, C. L.; Weeks, M. S.; Schinazi, R. F. Anti-HIV-1 activity, toxicity, and stability studies of representative structural families of polyoxometalates. *Journal of medicinal chemistry* **1990**, *33* (10), 2767–2772. DOI: 10.1021/jm00172a014.
8. Gumerova, N. I.; Rompel, A. Polyoxometalates in solution: speciation under spotlight. *Chem. Soc. Rev.* **2020**, *49* (21), 7568–7601. DOI: 10.1039/D0CS00392A. Published Online: Sep. 29, 2020.