Na$_{19}$ [NaAs$_4$W$_{40}$O$_{140}$Pd$_4$] $\times$H$_2$O a novel polyoxotungstate complex-synthesis and possible biological applications

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Statement of the Problem: Polyoxotungstate are inorganic compounds with a broad range of pharmacological properties (antiviral, antibacterial, anti-tumoral activities). The purpose of this study was to synthesize Na$_{19}$ [NaAs$_4$W$_{40}$O$_{140}$Pd$_4$] $\times$aq (As$_4$W$_{40}$Pd), a new Pd$^{2+}$ complex of Na$_{27}$ [NaAs$_4$W$_{40}$O$_{140}$] aq (As$_4$W$_{40}$), a polyoxotungstate cryptand and to assess the antimicrobial activity.

Method: The As$_4$W$_{40}$ cryptand was synthesized following methods already described in the literature. The complex was obtained by adding PdCl$_2$ solution to As$_4$W$_{40}$ solution at pH 4, maintaining temperature between 70-80 ºC. After purification the complex was analyzed by spectrometric methods, TGA, conductometry, X-ray diffractometry. The biological activity was studied in vitro on Gram positive and Gram negative bacterial strains by serial dilution method, with identification of Minimum Inhibitory (MIC) and Bactericidal Concentrations (MBC).

Findings: The As$_4$W$_{40}$Pd complex structure is a Leyrie assembly which consist of 4 identical tri lacunar Keggin anion structures ([AsW$_9$O$_{33}$]$^{9-}$) joined together by 4 WO$_6$ octahedra in a ring-like form with high symmetry. The Pd$^{2+}$ cation is central coordinated inside the structure, in active positions formed in the lacunar places with high electron density. In case of Pd complex a new vibration was noticed at 544 cm$^{-1}$ corresponding to Pd-O bond. The results obtained by serial dilution method are the following (MIC, MBC=mg/ml): As$_4$W$_{40}$Pd for Methicillin-resistant Staphylococcus aureus (MRSA, ATCC 44003, Gram positive) MIC=1.48, MBC=1.48; for Pseudomonas aeruginosa (ATCC 27853, Gram negative) MIC=23.69, MBC=23.69; As$_4$W$_{40}$ for MRSA MIC=1.00, MBC=1.00 for P. aeruginosa MIC=64.60, MBC=no effect.

Conclusion: A new complex was synthesized Na$_{19}$ [NaAs$_4$W$_{40}$O$_{140}$Pd$_4$]$\times$3H$_2$O. Both compounds exhibit remarkable antibacterial activity on strains resistant to current therapeutics. The complex was more efficient than the cryptand. MRSA have proved to be more sensitive than P. aeruginosa, which developed resistance to the cryptand. This class of compounds presents biological properties that deserve to be exploited and optimized further more.

References

Biography
Lavinia Berta is working as a Lecturer at General and Inorganic Chemistry Department, Faculty of Pharmacy, University of Medicine and Pharmacy, Tirgu Mures, Romania. Her expertise is in the field of inorganic chemistry-synthesis, identification and characterization of poly-oxymetallic compounds (UV-VIS, FT-IR, TGA and ICP). She has two national grants as Principal Investigator. She has many articles published and has participated in many national and international conferences.