Abstract

The subject of this doctoral dissertation is the synthesis of new oxidovanadium(IV) complex compounds with polycarboxylate ligands and the characterization of their physicochemical and biological properties.

In modern medicine, interest in the use of vanadium compounds for the treatment of diseases of various etiologies has been increasing year by year. Many researchers point out that these compounds may exhibit anticancer or insulin-mimetic properties. A major challenge encountered in the search for potential anticancer chemotherapeutic agents is balancing their beneficial effects with the side effects of therapy. One strategy to minimize adverse effects involves the use of coordination compounds, which has directed research attention towards the synthesis of novel oxovanadium(IV) derivatives.

The experimental part of this work describes the synthesis of oxidovanadium(IV) complex salts, in which the cationic part is an N-heterocyclic organic compound (e.g., quinoline, acridine), while the coordination anion consists of an oxidovanadium(IV) cation and polycarboxylate ligands. Eight complex compounds were obtained and divided into three series: **N1** – [QH]VO(nta)$(H_2O)_2$, **N2** – [(acr)H]VO(nta)$(H_2O)_2$, **N3** - [4,4'-dmo-2,2'(bpy)H][VO(nta)(H_2O)]H_2O (Q – quinoline, acr – acridine, 4,4'-dmo-2,2'(bpy) – 4,4'-dimethoxy-2,2'-bipyridine, nta – nitrilotriacetate ligand); **O1** - [QH][VO(acac)(oda)], **O2** – [isoQ(H)][VO(acac)(oda)]H_2O, **O3** - [acr(H)]VO(acac)$(oda)_2$ (isoQ – isoquinoline, acac – acetylacetonate ligand, oda - diglycolate ligand); **T1** – [QH][VO(acac)(tda)], **T2** – [acr(H)][VO(acac)(tda)] (tda – thiodiacetate ligand).

These compounds were structurally characterized using single-crystal X-ray diffraction and infrared spectroscopy. Potentiometric studies were performed to construct concentration–pH diagrams illustrating the distribution of different complex species in aqueous solution. Theoretical calculations provided insight into the bonding nature within the vanadium coordination sphere in heteroligand complexes.

Cytotoxicity assessments conducted on seven cell lines (both cancerous and non-cancerous) indicated moderate selectivity for certain compounds and confirmed their anticancer potential. The best results were obtained for the MG-63 (osteosarcoma) cell line, where at low concentrations some of the compounds exhibited greater selectivity than cisplatin. Heteroligand complexes (containing the $[VO(acac)(oda)]^-$ or $[VO(acac)(tda)]^-$ anion) proved to be more cytotoxic compared to the free cations (acridine and quinoline). Complex compounds containing a labile aqua ligand ($[VO(nta)(H_2O)]^-$) showed higher toxicity but lower selectivity.

This work contributes to the advancement of knowledge in the field of oxovanadium(IV) coordination chemistry. In the future, the obtained results may support the targeted design of compounds with potential pharmaceutical applications.