

OBTAINING COORDINATION COMPOUNDS OF SALICYLHYDROXAMIC ACID WITH 3D-METAL IONS AND STUDYING THE CRYSTAL STRUCTURE

Khushbokov Abduvali

PhD student of TerSU

Jamshid Mengnorovich Ashurov

[Prof. Academician Sadykov Institute of Bioorganic Chemistry](#)

Salicylic acid is usually a white or light-yellow crystalline powder, slightly soluble in water, and soluble in some organic solvents. Salicylic acid has two main functional groups:

1. Phenolic –OH group (located in position 2)
2. Hydroxyamide group ($-\text{C}(=\text{O})-\text{NHOH}$)

Due to these two groups, it acts as a bidentate ligand — that is, it binds to the metal ion from two places at once (through O atoms).

Salicylic hydroxamic acid often forms strong complexes with 3d-metal ions: it easily coordinates with Fe (III), Cu (II), Co (II), Ni (II), Mn (II), etc. It binds to the metal as an O, O'-bidentate ligand (through the phenolic OH and the $=\text{N}-\text{OH}$ oxygen atom of the hydroxyamide group). The complexes can be formed in the crystalline state and often have a chiral, polynuclear or cyclic structure.

Salicylic acid is an inhibitor of enzymes such as metalloproteases and urease. It can show antibacterial and antitumor activity. It is used as an indicator or reagent in the determination of iron (III) and other metal ions, and as a model substance in the formation of complexes with various ligands.

Salicylic hydroxamic acid is a biologically active bidentate coordination ligand that has been studied in limited quantities. It forms strong, stable complexes with 3d-metal ions.

In this scientific work, new coordination compounds with 3d-metal ions were synthesized based on salicylic hydroxamic acid. In the work, only salicylic hydroxamic acid was chosen as the main ligand, and no additional ligands were used. The synthesis reactions were carried out with 3d-metal salts such as Ni (II), Co (II), Cu (II), Mn (II). Ethanol, DMSO and DMFA were used as solvents. Crystals were obtained by natural evaporation, and some were obtained by heating at a constant temperature of 40° C.

X-ray diffraction (XRD) methods were used to analyze the resulting compounds. The resulting coordination compounds were obtained in the form of crystals of various colors, and their physicochemical properties were studied.

The crystal structures of the synthesized compounds were compared with the Cambridge Crystallographic Database (CCDC). As a result, the structures of the obtained crystals were consistent with previous data, so they were not included in the database as new structures. Nevertheless, the formation conditions, structural differences, and stability of the obtained crystals indicate that they are of theoretical and practical importance.

Based on the results of this study, it was proposed that the coordination properties of salicylic hydroxyamide acid could be further studied and that it could be used in the future as a biologically active, drug, or selective sorbent for capturing metal ions.

References

1. Shekaari, H., Dadrass, H. M., & Afzali, D. (2016). Crystal structures of Fe(III)-salicylhydroxamic acid complexes: Synthesis, spectral characterization and magnetic behavior. *Journal of Coordination Chemistry*, 69(4), 633–645. <https://doi.org/10.1080/00958972.2016.1139023>
2. Kargar, H., & Kia, R. (2019). Crystal structure and magnetic properties of a tetranuclear Fe(III) complex with salicylhydroxamic acid and pyridine. *Polyhedron*, 160, 248–254. <https://doi.org/10.1016/j.poly.2018.11.064>
3. Cambridge Crystallographic Data Centre (CCDC). (2023). Structures 2304064–2304067. Retrieved from <https://www.ccdc.cam.ac.uk>
4. Reedijk, J., & Bouwman, E. (1999). Coordination chemistry of hydroxamic acids. *Coordination Chemistry Reviews*, 184, 297–319. [https://doi.org/10.1016/S0010-8545\(98\)00207-6](https://doi.org/10.1016/S0010-8545(98)00207-6)
5. Royal Society of Chemistry. (n.d.). *Salicylhydroxamic acid*. ChemSpider. Retrieved June 16, 2025, from <http://www.chemspider.com/Chemical-Structure.13201.html>
6. National Center for Biotechnology Information (NCBI). (n.d.). *Salicylhydroxamic acid – Compound Summary (CID: 14713)*. PubChem. Retrieved June 16, 2025, from <https://pubchem.ncbi.nlm.nih.gov/compound/14713>