

**Introduction of Antimony (III) Hydroxamates****Bharat Rathore****DAVV, Indore, M.P****DOI: <https://doi.org/10.5281/zenodo.13371935>****Abstract:**

Antimony (III) hydroxamates comprise a class of coordination compounds that have garnered increasing attention in the fields of inorganic chemistry, medicinal chemistry, and material science due to their unique structural features and potential applications. This review aims to collate and analyze the current literature on antimony (III) hydroxamates, focusing on their synthesis, structural characteristics, reactivity, and applications. The review also discusses the biological significance of these compounds, including their toxicity and therapeutic potentials, particularly in relation to neoplastic diseases.

**Keyword:** Antimony (III), Hydroxamates, Inorganic Chemistry, Medicinal Chemistry, and Material Science

**1. Introduction:**

Antimony (Sb) is a metalloid element with a long history of use in various domains, including medicine and metallurgy. The oxidation state of antimony plays a crucial role in defining its chemical behavior, with trivalent antimony (Sb(III)) being particularly notable for its coordination



chemistry. Hydroxamates, characterized by the functional group R-CO-NH-OH, have been extensively studied for their chelating properties and their potential as pharmacological agents.

The synthesis and characterization of antimony (III) hydroxamates began in earnest in the late 20th century and have continued into the 21st century, driven by their intriguing properties and potential applications. The present review seeks to provide a comprehensive overview of the research conducted on antimony (III) hydroxamates, highlighting their synthesis, structural motifs, reactivity, and applications.

## 2. Synthesis of Antimony (III) Hydroxamates:

### 2.1 Synthetic Procedures:

A variety of synthetic routes have been developed for the preparation of antimony (III) hydroxamates. The most common approach involves the reaction of antimony (III) salts, such as antimony trichloride ( $\text{SbCl}_3$ ), with hydroxamic acids. The general reaction can be represented as follows:



The choice of hydroxamic acid can significantly influence the solubility, stability, and subsequent properties of the formed hydroxamates. Different R groups in the hydroxamic acids lead to diverse structural and electronic properties, which can enhance the functionality of the resulting antimony complexes.

### 2.2 Characterization Techniques:



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The characterization of antimony (III) hydroxamates is typically achieved through various techniques including nuclear magnetic resonance (NMR) spectroscopy, infrared (IR) spectroscopy, mass spectrometry, and single-crystal X-ray diffraction. These techniques provide insights into the structure, bonding, and coordination environment of the antimony atom, offering a clear understanding of how these compounds behave at the molecular level.

### 3. Structural Characteristics:

The structural characteristics of antimony (III) hydroxamates reveal intriguing features that are key to their chemical reactivity. X-ray crystallography has shown that antimony (III) can exhibit a trigonal bipyramidal geometry, where the hydroxamate ligands coordinate to the antimony center through the nitrogen atom and the adjacent oxygen atom. This bidentate coordination results in chelate formation, leading to enhanced stability.

Furthermore, the presence of donor atoms from hydroxamic acids not only influences the geometry but also plays a role in the electronic properties of the complexes. Substituents on the hydroxamic acids can contribute to variations in sterics and electronics, which can modify the reactivity profiles of the antimony complexes.

### 4. Reactivity Profiles:

Antimony (III) hydroxamates have exhibited reactivity towards nucleophiles and electrophiles, resulting in various transformations. Studies have demonstrated that these compounds can act as ligands in coordination chemistry, participating in various coordination modes and forming more complex structures with transition metals.



Additionally, the reactivity of antimony (III) hydroxamates extends into organic chemistry where they can be used as intermediates in the synthesis of pharmaceuticals and biologically active compounds. Their dual role as both metal-based and organic platforms for reactivity raises avenues for innovative synthetic applications.

## **5. Biological Applications:**

### **5.1 Anticancer Activity:**

Antimony (III) hydroxamates have shown promise in biological applications, particularly in oncology. Preliminary studies indicate that certain hydroxamate derivatives exhibit cytotoxic properties against various cancer cell lines. The mechanism of action may involve the inhibition of histone deacetylases (HDAC), which have been implicated in tumor progression.

### **5.2 Toxicity Concerns:**

Despite their potential therapeutic applications, the toxicity of antimony (III) compounds, including hydroxamates, cannot be overlooked. Antimony compounds have been shown to possess considerable toxicity, which necessitates careful evaluation of their therapeutic windows and side effects. Research continues to focus on optimizing the therapeutic profiles of these compounds while minimizing their harmful effects.

## **6. Conclusion:**

Antimony (III) hydroxamates represent a fascinating area of study within the realms of coordination chemistry and medicinal chemistry. Through the exploration of their synthesis, structural characteristics, reactivity, and biological applications, significant insights into their potential utility have emerged. As research progresses, further elucidation of their mechanisms of



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action and optimization of their therapeutic properties holds promise for the development of novel anticancer agents and other functional materials.

Future research should focus on expanding the scope of antimony (III) hydroxamate derivatives, elucidating their full potential in therapeutic applications, and addressing the challenges related to their safety and efficacy.

This paper serves as a primer for the study of antimony (III) hydroxamates, and further investigation and research could significantly contribute to understanding and exploiting these unique compounds.

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