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## **Metal Complexes in Drug Research - A Review**

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### **ABSTRACT**

*Metal compounds provide new opportunities for building structures with defined properties. A number of diseases and their treatment dependent on the metabolism of inorganic constituents. The advances in inorganic chemistry provide better opportunities to use metal complexes as therapeutic agents. The mode of action of metal complexes on living organism is differing from non metals. These complexes show a great diversity in action. Metal coordination to biologically active molecules can be used to enhance their activity. This paper reviews about the various applications of metal complexes in biological system.*

**Key words:** Metal complexes, Biological activity, Inorganic constituents.

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### **INTRODUCTION**

Organo-metallic compounds have been used in medicine for centuries. Metal complexes play essential role in pharmaceutical industry and in agriculture. The metallo-elements present in trace quantities play vital roles at the molecular level in living system. The transition metal ions are responsible for proper functioning of different enzymes. The activity of biometals is attained through the formation of complexes with different bioligands and the mode of biological action for complexes depends upon the thermodynamic and kinetic properties. The lipophilicity of the drug is increased through the formation of chelates and drug action is significantly increased due to effective permeability of the drug into the site of action. Interaction of various metal ions with antibiotics may enhance their antimicrobial activity as compared to that of free ligands.

**Metal Complexes**

Metal complexes are also known as coordination compounds, which include all metal compounds. Metal complex is a structure consisting of a central atom (or) ion (metal) bonded with anions (ligands). Compounds that contain a coordination complex are called coordination compounds. Metals are Lewis acid because of their positive charge, when dissolved in water they form hydrated compounds.

**Metal Complexes in the Body**

Metal ions bond with ligands in some process, and to oxidize and reduce in biological systems. The important metal present in the body is iron which plays a central role in all living cells. Generally iron complexes are used in the transport of oxygen in the blood and tissues. An adult at rest consumes 250ml of pure oxygen per minute, this oxygen carried by the metal complex transport system known as heme, allowing the oxygen to leave the blood when it reaches the tissue. The heme group is metal complex, with iron as central metal atom, which bind or release molecular oxygen.

**Metal Complexes in Cancer Treatment**

Metal complexes have a higher position in medicinal chemistry. The therapeutic use of metal complexes in cancer and leukemia are reported from the sixteenth century. In 1960 an inorganic complex cisplatin was discovered, today more than 50 years, it is still one of the world's best selling anticancer drug. Metal complexes formed with other metals like copper, gold, gallium, germanium, tin, ruthenium, iridium was shown significant antitumor activity in animals.

Recent progress in the field of cell biology provide new targets for anticancer agent which act by the formation of DNA adducts with cancer cell and results in the inhibition of DNA replication [1]. It also affects normal cells like hair follicles, mucus lining of gastrointestinal tract. Different techniques have been used to modify such effects by reducing its side effects, avoiding drug resistance and to improve efficacy [2]. For example the drugs have been conjugated with porphyrin ring to enhance the tumor tissue specificity of complexes. Apart from platinum some other transition metals also used as anticancer drugs. Titanium complexes, gold complexes also show significant antitumor activity. In the treatment of ovarian cancer ruthenium compounds containing arylazopyridine ligands show cytotoxic activity. Now a day's metal complex in the form of nanoshells are used in the treatment of various types of cancer [3].

**Metal Complexes in Neurological Disorder**

Metal complexes are also play a vital role in the treatment of various neurological disorders. Lithium on complex with drug molecules may cure many nerve disorders like Huntington's chorea, Parkinsonism, organic brain disorder, epilepsy and in paralysis etc. Other transition metals such as copper and zinc are involved as a transmitter in the neuronal signaling pathways [4].

**Metal Complexes in Diabetes**

Diabetes mellitus is a complex disorder that demands multi-modal therapy. It is a chronic disorder characterized by a high blood glucose concentration which is called as hyperglycemia and caused due to insulin deficiency and insulin resistance. In diabetes intake of chromium metal complex shown considerable reduction in the glucose level [5]. New insulinomimetic zinc (II)

complexes with different coordination structures and with a blood glucose lowering effect to treat type 2 diabetes in animals were found [6].

### **Metal Complexes of Schiff Bases**

A metal surrounded by cluster of irons or molecules named as Schiff bases which are products of primary amines condensed with aldehydes (or) ketones ( $RCH=NR'$ , where RPR' are alkyl and (or) aryl substituents).

Schiff base with metals such as thallium, molybdenum, manganese, zinc, cadmium, copper and silicon form complexes show impaired antimicrobial property when compared with Schiff base. Example- Schiff base of pyrrolidone, pyridone with O-phenylenediamine and their metal complexes show better antibacterial activity [7].

Schiff base with metals such as Arsenic, antimony and bismuth show considerable antifungal property against *A.niger* and *A.alternata*. Example Schiff bases and their metal complexes formed between furan (or) furylglyoxal with amines show antifungal activity against various organisms [8].

Schiff base with silver show considerable antiviral activity. Example silver complexes in oxidation state showed inhibition against cucumber mosaic virus [9].

Apart from antimicrobial, antifungal, antiviral activity, Schiff bases with their metal complexes possess anti-inflammatory, allergic inhibitory, antioxidant and analgesic action. Example- Furan semicarbazone metal complexes exhibit significant antihelmintic and analgesics activities [10].

Schiff base metal complexes possess significant antifertility and enzymatic activity [11]. Also chromium azomethine complexes, cobalt complex of Schiff bases are used in dyes for giving color to leathers, food package and wool [12].

## **CONCLUSION**

Metal complexes offer a platform for the design of novel therapeutic compounds. The basic ideas for the synthesis and develop the various process in metal complex is under progress. Even though it having more side effects, they are still widely used in the treatment of cancer as a therapeutic drug. Regardless of the achievements of current metal complex drugs, there are some drawbacks. Therefore there is a need for new approaches that are required to circumvent these drawbacks.

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