

Applications of metal complexes of Schiff bases-A Review

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Abstract: Schiff base metal complexes of transition metals and the Schiff base itself formed by the condensation of carbonyl compounds with various amines are extensively used as catalyst in wide range of reactions useful both in industrial and laboratory purpose. Biological application based on antibacterial and antifungal activity form a major area of study in this regard. The anticancer activity of such compounds is one newly emerging field. They have usage in various industrial applications such as dyes and on polymer.

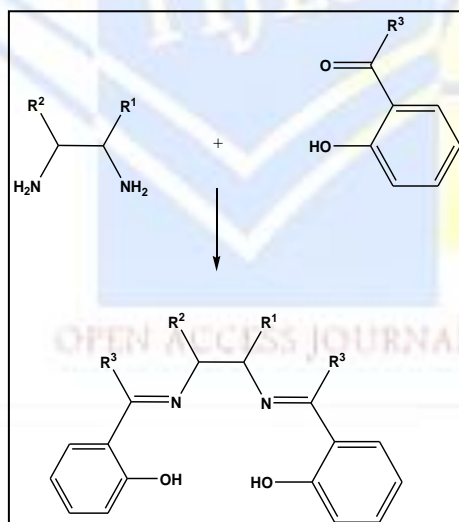
Index Terms: Schiff bases, metal complexes, biological activity, catalysts.

1. Introduction

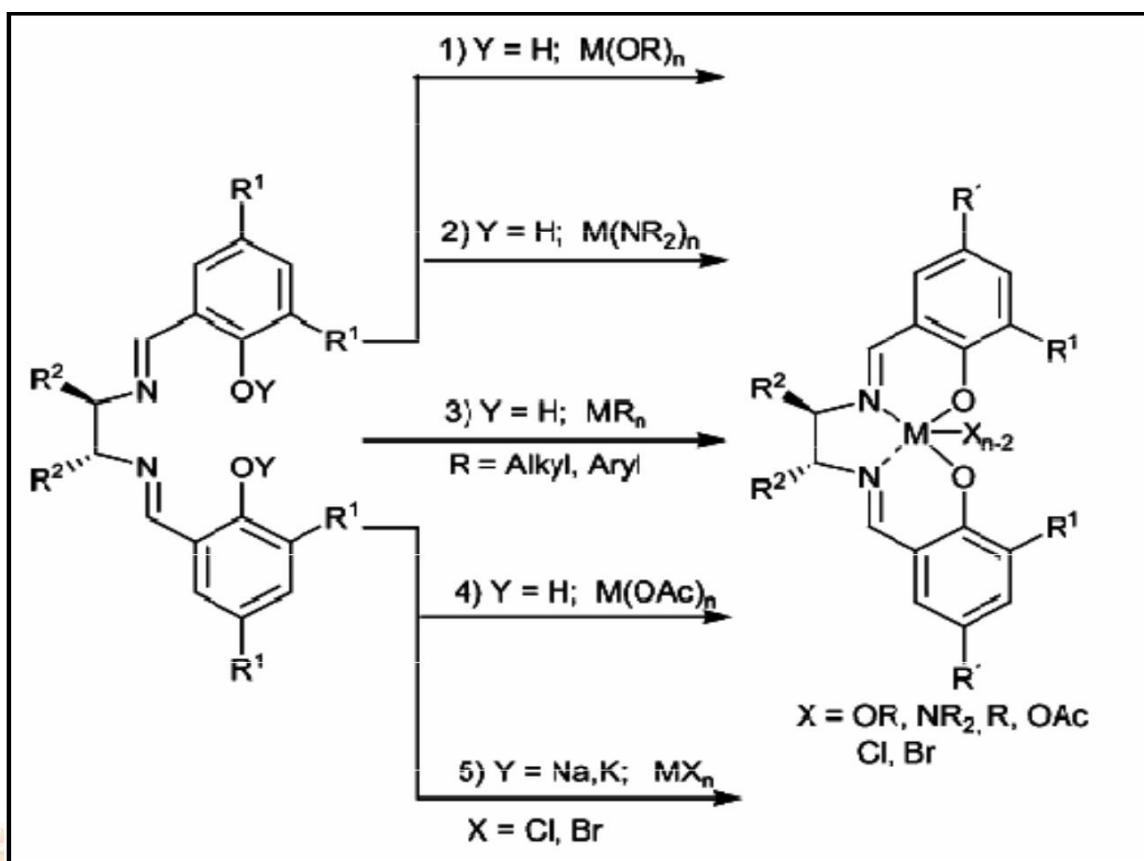
Schiff bases, formed by the condensation reaction of amino and carbonyl compounds constitute an important subject for a wide range of research [1]. The C=N bond is particularly responsible for various biological activity imparting antimicrobial, antibacterial, antioxidant, anti-inflammatory and antifungal characteristics in such compounds [2].

Research on Schiff base metal complex is increasing day by day. They play a major role in the advancement of modern coordination chemistry along with various fascinating roles in the inorganic biochemistry, drug synthesis and catalysis [3].

The role of Schiff base is wide and varied. As catalyst they are important in various chemical reactions in laboratory as well as in industry. This articles throws light on this aspect as well.



Preparative route for Schiff Base.



General Preparation of Schiff base complexes

2. Application of transition metal complexes:

2.1 Antibacterial activity

Schiff base metal complexes formed from 2-thiophene carboxaldehyde and 2-amino benzoic acid with metals such as Co(II), Ni(II) were found to possess significant antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus pyogenes*. The implication of the study is that these metal complexes could be used for the treatment of diseases infected by any of the aforementioned strains[4].

It was found that Schiff bases formed by the condensation of salicylaldehyde and 2-furaldehyde with various phenylenediamines upon complexation with Platinum(II) were found to have more antimicrobial activity than the Schiff bases themselves[5].

In one unique study of a new Schiff base and its metal complexes, lipophilicity is one major factor on the antibacterial property of both the Schiff base and its metal complexes. This is particularly important against gram negative bacteria such as *E. coli*. Thus metal complexes of Schiff base formed from sulphametrole and vanillin combine with the lipophilic layer of such bacteria, facilitating their entry into the microorganism and thus inhibiting subsequent growth[6].

Chelation is often found to play a major role in the antibacterial properties of many Schiff base complexes as metal chelates have both the polar and non-polar characteristics facilitating their permeability to the inside of the cell. This helps in understanding the order of antibacterial properties of Schiff base complexes from Indole-3-carboxaldehyde and m-aminobenzoic acid following the order as Cu(II) > Co(II) > Ni(II) > Zn(II) > ligand [7].

MTT method was used for the study of the antibacterial properties of Schiff base 4-chloro-2-(2-morpholino ethylimino methylphenolato methanochloro and its Zn(II) complex against both gram positive [*B. subtilis*] and gram negative [*E. coli*] bacteria. The Schiff base was seen to have perceptible antibacterial property against gram positive bacteria but no such property against gram negative bacteria. Whereas the metal complex showed significant antibacterial property against both the gram positive and gram negative bacteria and similar or compared to commercial antibiotics such as kanamycin and penicillin[8].

2.2 Anti cancer activity

Cancer is an uncontrolled growth of cells, destroying other normal cell and ultimately leading to metastasis [9]. Cancer has become second cause of death of human in the whole world [10].

Though surgery and chemotherapy are first lines of treatment, the side effects of the conventional drugs are overwhelming. So there has been a constant and focussed research on novel drug synthesis since many decades. Modern research as Schiff base complexes show very promising findings in this regard.

Complexes of rare earth ions with Schiff base salicylaldehyde-L- phenylalanine showed excellent anticancer potential on K562 tumor cell [11].

A novel metal complex of Cd with Schiff base derived from 2-acetylpyridine and L-tryptophan was found to induce apoptosis on human breast cancer MDA-MB-231 cells [12]. In one colon cancer study, $\text{Cu}(\text{BrHAP})_2$ Schiff base compound was found to induce apoptosis on HT-29 cells and this makes it a potential candidate to be used as a substitute drug for colon cancer treatment[13].

2.3 Antifungal activities

Schiff bases derived from thiazole and benzothiazole were found to have antifungal properties [14] which are further enhanced by methoxy, halogen and naphthyl groups present in those compounds [15].

Schiff base derived from furfurylidene nicotinamide was found to have considerable such properties against *A. niger*, *Alternaria solani* and *Collectotricum capsici*[16]. Schiff base metal complex from hydrazine and carbothioamide is a promising candidate against *A. alternata* and *H. graminicum* [17].

Similar antifungal property on *A. niger* and *A. alternata* is shown by benzothiazole or phenyl-azo-thiazole based Schiff base metal complexes [18]. Antifungal activity is also shown by oxovanadium(IV) complexes with triazole[19].

2.4 Anti viral activities

Major antiviral property is exhibited by Schiff bases of gossypol[20]. Cucumber mosaic virus growth is regulated by Silver(I) complex with glycine salicylaldehyde Schiff base [21].

2.5 Polymer

Amine terminated natural rubber(ATNR) forms poly Schiff base with glyoxal which prevents photochemical degradation which is otherwise found with natural rubber[22]. Initiator is essential in vinyl polymerisation. Some organocobalt complexes with tridentate Schiff base act as such[23].

2.6 Dyes

Schiff base chromium complex based dyes are used as coloring materials for leathers [24]. Some Schiff base complexes are used as dyeing agents for polyester based textiles[25]. They have also usage on polyfibres[26].

2.7 Catalysts

Hydroxy benzaldehyde based Schiff base metal complexes with Co(II), Fe(II) and Ru(III) play role as catalyst in the oxidative preparation of cyclohexanol from cyclohexane[27]. In oligomerization Of ethylene, neutral bis(iminopyridyl) benzene and monoanionic Schiff base binuclear complexes with Fe,Co,Ni, Zn are used as catalysts[28]. In various organic reactions chromium-salen complexes have major use as catalysts[29]. In various organic synthesis reactions, many Schiff base Co(II) complexes are used as oxygen carrier due to their ability to bind dioxygen more or less reversibly [30]. Amino acid based Schiff base copper complexes can hydrolyse at a much faster rate than Cu(II) ions in various reactions[31]. Cyanohydrin cobaltate complexes are used as catalysts. In oxygenation of alkene Co(II) Schiff base chelate complexes exhibit catalytic property[32].

3. Conclusion: Research and study on Schiff base metal complexes of transition metals is increasing by the day as they have wide range of multifaceted usage in starting from catalysts to various biological applications.

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