Powder XRD analysis

The powder X-ray diffraction of some selected cobalt complexes were obtained in solid form. The X-ray diffractogram of all complexes showed broad peaks, which indicate amorphous nature[35]. Though amorphous nature of complexes was observed they were generally not soluble in non-polar solvents.

Electronic absorption spectra

In the present study, UV-visible spectrum of the ligand displays two strong bands in the region 260–340 nm, which are assigned to n→π* and π→π* transitions[36]. The observed λ_{max} values for all the synthesized ligands are found to be nearly same. The λ_{max} values for the synthesized ligands are represented in Fig. 1.

The UV-visible spectra gave support in establishing geometry of the synthesized metal complexes. In the present investigation due to organic ligands the absorption bands observed in the range 280 nm and 360 nm are attributed to π→π* and n→π* transitions. The shift in absorption frequencies of these bands supports for involvement of oxygen atom of phenol and nitrogen atom of azomethine linkage in coordination with metal. The absorption spectra for Co(II) complexes showed absorption bands in the region 450 – 540 nm which are assignable to charge transfer band suggesting square planar geometry around Co(II) ion[37]. Electronic spectral data of Co(II) complexes were recorded in DMF as solvent and presented in Fig. 2.

Thermal analysis

The thermogram of cobalt complexes showed two stage decompositions in the temperature range 220- 800 °C. There is no significant weight loss below 250 °C supports for no lattice or coordinated water molecules in Co-1 and Co-5 complexes and they are highly stable. In Co-1 and Co-5 complexes with salicyloylpyrazoleoximes a significant weight loss begins at 250 °C. The anhydrous compound does not remain stable at higher temperature. The complexes started to decompose slowly, then more rapidly in the range 220- 750 °C with percent weight loss corresponding to decomposition of organic matter. The decomposition completed by leaving air stable residue as CoO obs. % (Cal-10.53 %) for Co-1 and CoO obs. 9.03% (Cal- 9.60%) for Co-5 complexes. The TG plots for selected metal complexes are shown in presented in Fig. 3.

Fig. 1 — Electronic absorption spectrum of the ligand (a) HL2 and (b) HL4

Fig. 2 — Electronic absorption spectra of complex (a) Co-2 and (b) Co-4

Antibacterial activity

All the synthesized ligands and cobalt complexes were tested against gram positive bacteria *Bacillus subtilis, Staphylococcus aureus,* Actinomycetes and gram negative bacteria *Klebsiella, Pseudomonas aeruginosa.* The newly synthesized complexes exhibited varying degree of inhibitory effect (low to moderate) on the growth of tested bacteria. The antibacterial data for the synthesized ligand and complexes are presented in Fig. 4.

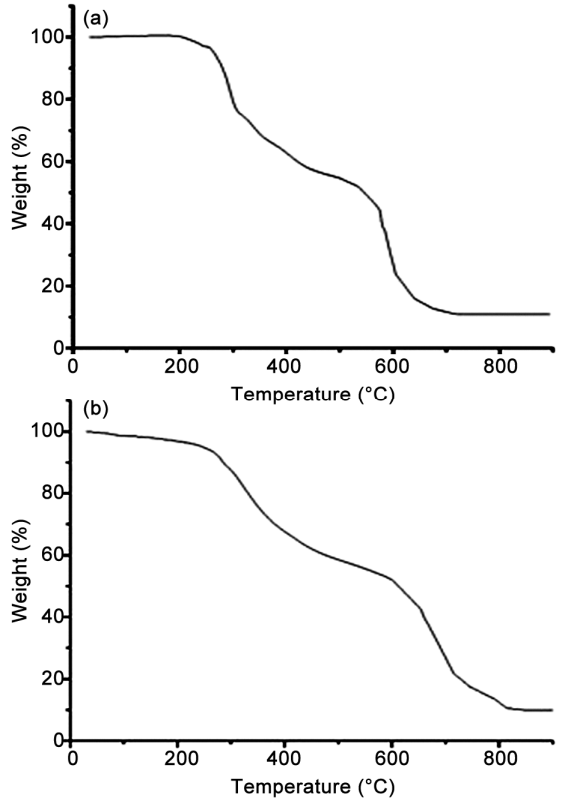

Fig. 3 — TGA plot of complex (a) Co-1 and (b) Co-5

However, in antimicrobial screening the synthesized Schiff base metal complexes were found comparatively much more active than the free ligands. The antimicrobial activity of metal complexes showed considerable zone of inhibition compared to that standard drug Penicillin. Most of the synthesized complexes showed antimicrobial activity against *Actinomycetes* and *Pseudomonas aeruginosa*. After coordination with metal ion, the compounds which are biologically inactive becomes active and biologically less active compounds becomes more active[38,40]. Such introduction and enhancement in the activity of metal complexes were explained on the basis of Overtone's concept[41] and Tweedy's chelation theory[42].

The dissimilarity in the activity of the different metal complexes against different bacteria depends either on the impermeability of the cells of the microbes or difference in the ribosomes in the microbial cells[43,44]. The metal complexes may also be a vehicle for activation of the ligand as a cytotoxic agent. Moreover, complexation may lead to significant reduction of drug resistant[45]. Besides this other factor such as solubility, conductivity and dipole moment influenced by the presence of metal ions may also be the possible reason causing enhancement of the antimicrobial activity of chelate complex as compared to free Schiff base compounds[46]. The antimicrobial activity may also enhance due to involvement of formation of hydrogen bond through the azomethine group with the active centers of cell constituents, resulting in an interference with normal cell process[47].

Now it is clear that, these compounds possess antibacterial properties. Use of these compounds as antibacterial on therapeutic scale need to be further

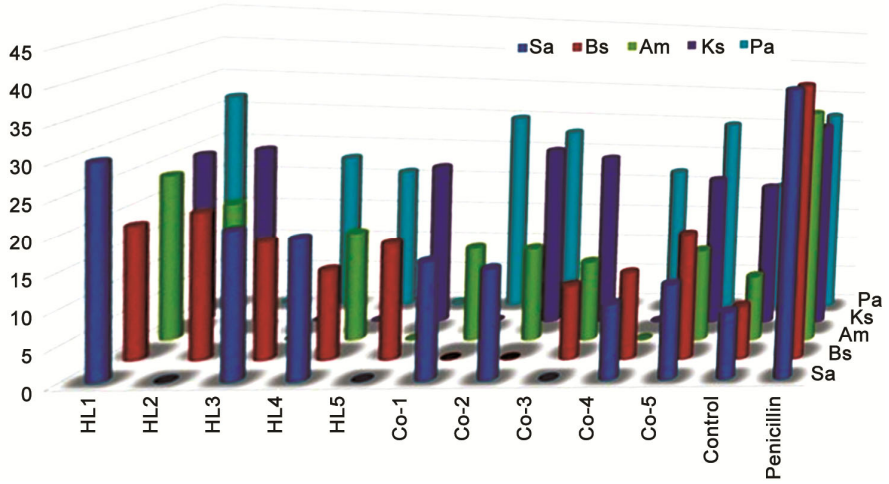

Fig. 4 — Antimicrobial activity of salicyloylpyrazoleoxime and Co(II) complexes

elaborated. In many cases the bacterial pathogens have acquired resistance against traditional compounds or drugs. Under such conditions, these new compounds can be tried as alternative compounds for the control of these pathogens. However, further studies in this direction are needed.

Conclusions

In this present study, new salycyloylpyrazoleoxime and its cobalt complexes are reported. The formation of metal complexes confirmed by UV-visible, IR and ^{1}H NMR spectroscopy. The spectral data suggest that the oxygen atom of phenol group and nitrogen atom of imine group are involved in coordination with metal ion. The formation of metal complexes is also confirmed by thermal methods of analysis. All the metal complexes are stable below 200 °C and decompose slowly after 200 °C giving formation of corresponding metal oxide. The complexes are insoluble in water, alcohol and other organic solvents but good solubility in DMF and DMSO. The electronic absorption spectra suggest probable square planer geometry. The molar conductance values of these complexes suggest the non-electrolytic nature. The antibacterial study revealed that the most of the ligands and metal complexes possess moderate antimicrobial activity.

Supplementary Data

Supplementary Data associated with this article are available in the electronic form at http://nopr.niscair.res.in/jinfo/ijca/IJCA_60A(11)1437-1442_SupplData.pdf.

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