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Study of Antimicrobial Screening of p- Methoxy Isonitroso Acetophenone with Palladium (II) and Platinum (II)

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ABSTRACT: A Schiff base and its Pd(II), Pt(II) complexes have been synthesized. The characterization of ligand p-methoxy isonitroso acetophenone (p-MINAP), Pd(II) and Pt(II) complexes have been studied by elemental analysis, molar conductance, magnetic susceptibility, Electronic, Infrared, ^{1}H NMR spectroscopy. On the basis of molecular weight, magnetic susceptibility and spectral data, octahedral geometry has been assigned to Pd(II) and Pt(II) complexes. Antimicrobial screening of Pd(II) and Pt(II) was carried out with p-methoxy isonitroso acetophenone(p-MINAP). This shows potent biological activity against gram positive bacteria B. cereus, B. subtillis, S. aureus and gram negative bacteria E. coli, K. pneumonae, P. aeruginosa and fungi A. niger, F. oxysporium, C. albicans by using agar dilution method.

Keywords: p-MINAP; Pd (II); Pt (II); Magnetic Susceptibility; Spectral data; Antimicrobial screening.

INTRODUCTION: Schiff base metal complexes possess extensive application in various fields of human interest like biological, analytical, clinical and industrial area [1-3]. In recent years, metal complexes with Schiff base shows much more potent antibacterial effect against some microorganisms than standard drugs [4-6]. In coordination chemistry, Schiff base play a vital role due to simplicity in their synthesis, different properties and medicinal applications. A number of transition metal complexes with Schiff base acts as an antibacterial and antifungal agents [7-9]. Schiff bases are considered to be very good chelating agents [10], specially when –OH functional group closed with azomethine group. This paper describes the synthesis of Pd(II) and Pt(II) transition metal complexes with the ligand namely p-methoxy isonitroso acetophenone (p-MINAP) have been characterized by various physicochemical technique namely Elemental Analysis, Infrared spectroscopy, 1H NMR spectroscopy and were also screened for antibacterial activities against some species of microorganisms.

MATERIALS AND METHODS: All the chemicals used were of analytical grade. Solvents used were of analytical grade and purified by standard procedures [11].

Preparation of Pd (p-MINAP)2 complex: 0.355 g of Palladium chloride was dissolved in a minimum Volume of alcohol and equal quantity of water was added. Similarly 0.716 g of p-methoxy isonitroso acetophenone was dissolved in a minimum quantity of alcohol and equal volume of water was added. The solution of Palladium (II) was added to the reagent solution drop wise with continuous stirring in a conical flask. The pH was adjusted to 2.5 to 3.2 using buffer tablets. Then the solution was kept in a boiling water bath for 20 minutes, a colored complex was separate out. It was filtered, washed with water and then alcohol, dried at 100oC for 3 hours and analyzed for Palladium, carbon, hydrogen and nitrogen.

Preparation of Pt(p-MINAP)2 complex: 0.265 g of Platinum (II) chloride was dissolved in a minimum Volume of alcohol and equal quantity of water was added. Similarly 0.358 g of p-methoxy isonitroso acetophenone was dissolved in a minimum quantity of alcohol and equal volume of water was added. The solution of Platinum was added to the reagent solution drop wise with continuous stirring in a conical flask.

The pH was adjusted to 3.5 to 4.2 using buffer tablets. Then the solution was kept in a boiling water bath for 35 minutes, a colored complex was separate out. It was filtered, washed with water and then alcohol, dried at 100°C for several hours and analyzed for Platinum, carbon, hydrogen and nitrogen.

Antimicrobial Screening: Antibacterial activity of the ligand and complexes were determined by the agar well dilution method [12]. *B. cereus, B. subtillis, S. aureus, E. coli, K. pneumonae and P. aeruginosa.* Strains of three bacterial species which included Gram-positive bacteria, namely *B. cereus, B. subtillis, S. aureus* and Gram-negative bacteria namely *E. coli, K. pneumonae* and *P. aeruginosa* were investigated. Gentamycin and Miconazole were used as the standard antibacterial and antifungal agents respectively. The bacteria isolates were subcultured on nutrient agar plates and incubated at 37˚C for 24 h. A loop full of bacteria cells from the nutrient agar plates was incubated into a nutrient broth (50 ml) at 37˚C for 18 h with vigorous shaking. Using a sterile glass spreader, 18 h bacterial cultures (5 µl) were used to spread a bacterial lawn on nutrient agar [13]. The bacterial strains were grown at 37˚C overnight and maintained on nutrient agar. A stock solution of the compounds were prepared in DMF at 48˚C to give a final concentrations; after pouring into plates and allow the agar to set, plates were inoculated with standardized inocula of the test bacteria, and further incubated at 37˚C for 24 h under aseptic conditions.

RESULTS AND DISCUSSION: The synthesized compounds were colored, crystalline, stable in air, non-hygroscopic, and insoluble in water but soluble in polar solvent like DMF and DMSO. Composition and identity of the ligand and its metal complexes were carried out by elemental analysis and molar conductance's are listed in Table-1 shows metal complexes have non electrolyte nature [14]. The structure of the synthesized ligand and its metal complexes were established with the help of spectral techniques. The spectroscopic data for the newly synthesized metal complexes are in good agreement with proposed formulation.

Infrared Spectra: I.R. spectra (4000-400 cm^{-1}) of the complexes are practically identical. The frequencies of some significant band of the free ligand and those of the metal complexes are reported in Table 2. The observed frequencies of different groups in the metal complexes have been assigned on the basis of literature data.

Table 1: Elemental analysis data of the Ligand and its metal complexes.

Compound	Mol. Formula	Colour	Mol. Wt.	C% Found (calc)	H% Found (Calc)	N% Found (Calc)	O% Found (calc)	Metal %	Molar Condu. $Ohm^{-1}cm^2mol^{-1}$
p-MINAP	$C_9H_9O_3N$	yellow	179.16	60.30 (60.33)	5.12 (5.06)	7.75 (7.82)	26.83 (26.79)	-----	----
$Pd(p\text{-}MINAP)_2$	$Pd(C_{18}H_{18}O_6N_2)$	yellowish	464.75	46.50 (46.52)	3.92 (3.90)	6.05 (6.03)	20.61 (20.66)	22.92 (22.90)	10.2
$Pt(p\text{-}MINAP)_2$	$Pt(C_{18}H_{18}O_6N_2)$	gray	553.4	39.10 (39.07)	3.29 (3.28)	5.02 (5.06)	17.37 (17.35)	35.22 (35.25)	9.5

The vO-H of the oxime group observed at 3317 cm-1 in (p-MINAP) is absent in the spectra of the complexes suggesting replacement of the oxime proton by the metal ion during complexation [15]. The peak observed near 1602, 1610 cm-1 in spectrum of Pd (p-MINAP)2 and Pt(p-MINAP)3 may be assigned to the perturbed vC=0 and /or vC=N stretching vibration involving bonding through oxygen, and nitrogen donor atoms. A band appears in the range 1300-1200 cm-1 is reported that N-oxide (N→O) stretching mode in aromatic ring compounds [16]. It is significant to note that for metal complexes reported to have coordination only through the oxime oxygen or nitrogen atoms only. This suggests asymmetrical five member ring structure. In Pd(II) and Pt(II) complexes two bands in the region cited earlier on asymmetrical structure with five member rings involving bonding through oximes nitrogen atom must be expected, such symmetrical structures.

Table 2: Infrared Spectral Frequencies (4000 to 400 cm^{-1}) of ligand and metal complexes.

Assignment	p-MINAP	$Pd(p\text{-}MINAP)_2$	$Pt(p\text{-}MINAP)_2$
Aromatic C-H	3018.70	3071.76	3080.69
OH of =N-OH	3317.39	----	----
-C=O	1710.51	----	----
-C=N	1610.11	1602.31	1610.15
$-OCH_3$	2840.23	2864.63	2861.93
=C-H	1440.12	1443.22	1446.33
=N→ O	----	1243.82	1246.49
Para Substituent	766	782.46	783.46
M-N	----	657.17	645.57

^{1}H NMR Spectra: NMR Spectra of p-MINAP, Pd(p-MINAP)2 and Pt(p-MINAP)2 in DMSO solution exhibit peaks due to –CH group, -OCH3 group & Ca and Cb of aromatic ring protons & does not show any proton signal due to =N-OH group. This suggest that their complexes have been formed by the replacement of the proton of the =N-OH group by the metal ion. It

is interesting to note that the peaks due to –CH protons in Fe(p-MINAP)2 appear at similar value compared to that of –CH proton in the reagent p-MINAP. Further signals of aromatic ring protons in these complexes occur at higher field side with respect to that of aromatic ring signal in P-MINAP. The donar atom is closest to the metal ion which involved in the formation of metal ligand bond.

Nuclear magnetic resonance signals observed in p-methoxy isonitroso acetophenone (p-MINAP) and its metal complexes are shown in Table 3.

Table 3: Assignments of 1H NMR Signals in p-MINAP & Metal Complexes (All Values in δ scale).

Compound	Mol. Formul	Colour	Mol. Wt.	C% Found (calc)	H% Found (Calc)	N% Found (Calc)	O% Found (calc)	Metal %	Molar Condu. Ohm^{-1}cm^{2}mol^{-1}
p-MINAP	$C_9H_9O_3N$	yellow	179.16	60.30 (60.33)	5.12 (5.06)	7.75 (7.82)	26.83 (26.79)	-----	----
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Pt(p-MINAP)$_2$	$Pt(C_{18}H_{18}O_6N_2)$	gray	553.4	39.10 (39.07)	3.29 (3.28)	5.02 (5.06)	17.37 (17.35)	35.22 (35.25)	9.5

Antimicrobial activity: Antibacterial activity of the synthetic metal complexes of p-methoxy isonitroso Acetophenone was examined against gram positive bacteria B. cereus, B. subtillis, S. aureus and gram negative bacteria E. coli, K. pneumonae, P. aeruginosa. Antifungal activity of the same compounds was evaluated against C. albicans, A. niger and F. oxysporium. Assays were performed in agar media with final concentration of 500 µg/mL. All the synthesized compounds are effective at this concentration of 500 µg/mL. The results showed that the ligand (p-MINAP) and synthesized complexes of p-MINAP exhibited poor to good antibacterial and antifungal activities against all the tested strains. Complexes of Pd(p-MINAP)2, and Pt(p-MINAP)2 were shown maximum zone of inhibition and hence were found to inhibit the growth of all tested strains of bacteria and fungi. It may be due to the more penetrating power of platinum complexes to the cell wall of bacteria, which prevents the biosynthesis of peptidoglycan or may find better fit at the receptor site as compared to other compounds. Though the ligand exhibited antibacterial and antifungal activity against all the tested strains, its activity is less when compared with its metal complexes and hence suggested its unsuitability against all the strains. None of the synthesized complex showed more activity as compared to the standard drug.

Table 4: Antibacterial Activity Data of p-MINAP & Synthesized Complex.

Compound	Mol. Formul	Colour	Mol. Wt.	C% Found (calc)	H% Found (Calc)	N% Found (Calc)	O% Found (calc)	Metal %	Molar Condu. Ohm^{-1}cm^{2}mol^{-1}
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Pt(p-MINAP)$_2$	$Pt(C_{18}H_{18}O_6N_2)$	gray	553.4	39.10 (39.07)	3.29 (3.28)	5.02 (5.06)	17.37 (17.35)	35.22 (35.25)	9.5

Table 5: Antifungal Activity Data of P-MINAP & Synthesized complex.

Compound	Mol. Formul	Colour	Mol. Wt.	C% Found (calc)	H% Found (Calc)	N% Found (Calc)	O% Found (calc)	Metal %	Molar Condu. Ohm^{-1}cm^{2}mol^{-1}
p-MINAP	$C_9H_9O_3N$	yellow	179.16	60.30 (60.33)	5.12 (5.06)	7.75 (7.82)	26.83 (26.79)	-----	----
Pd(p-MINAP)$_2$	$Pd(C_{18}H_{18}O_6N_2)$	yellowish	464.75	46.50 (46.52)	3.92 (3.90)	6.05 (6.03)	20.61 (20.66)	22.92 (22.90)	10.2
Pt(p-MINAP)$_2$	$Pt(C_{18}H_{18}O_6N_2)$	gray	553.4	39.10 (39.07)	3.29 (3.28)	5.02 (5.06)	17.37 (17.35)	35.22 (35.25)	9.5

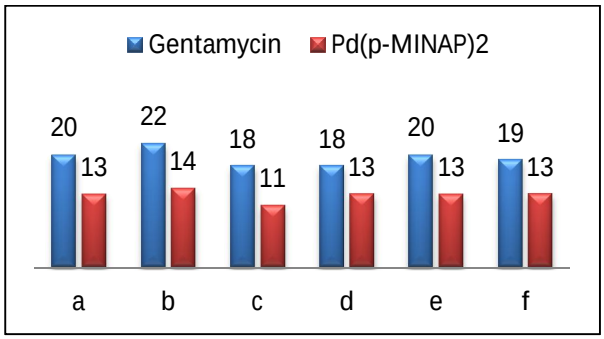

Figure 1: Antibacterial activity of parent Gentamcin and Pd(II) complex of p-MINAP.
[E.coli (a), S. aureus (b), P. aeruginosa (c), B. subtilis (d), B. cereus (e), K. pneumonia (f)]

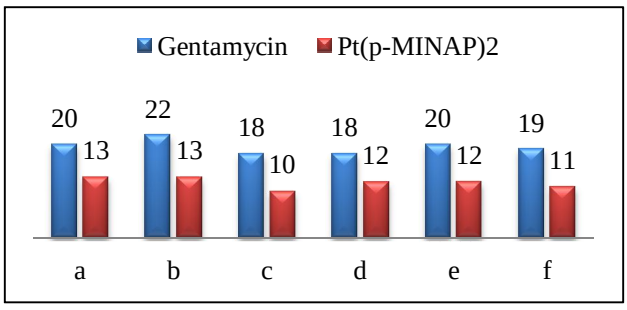

Figure 2: Antibacterial activity of parent Gentamycin and Pt(II) complex of p-MINAP.
[E.coli (a), S. aureus (b), P. aeruginosa (c), B. subtilis (d), B. cereus (e), K. pneumonia (f)]

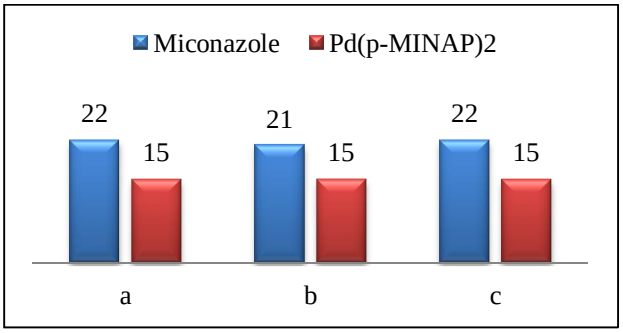

Figure 3: Antifungal activity of parent Miconazole and Pd(II) complex of p-MINAP.
[C. albicans (a), A. niger (b), F. Oxysporium (c)]

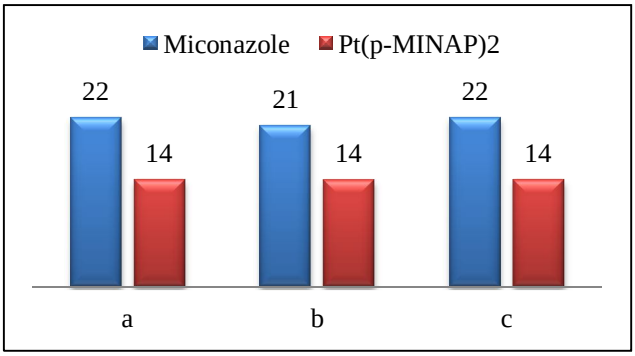

Figure 4: Antifungal activity of parent Miconazole and Pt(II) complex of p-MINAP.
[C. albicans (a), A. niger (b), F. Oxysporium (c)]

CONCLUSION: On the basis of analytical, IR, 1H NMR spectral data and magnetic properties, the metal ligand composition was found to be 1: 2. The geometry of complex octahedral geometry has been assigned to Pd (II) and Pt (II) Complex. Invitro, Antibacterial and Antifungal screening of these relived that most of the compounds exhibited potted inhibited potential activity.

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REFERENCES:

1. Mittal P., Uma V., *Der Chemica Sinica*, 1(3), 2010, 124.
2. Kumar S., Dhar D. N. and Saxena P. N. Applications of Metal Complexes of Schiff Bases-A Review. Journal of Scientific and Industrial Research, 68, (2009), 181-187.
3. Johari R., Kumar G., Kumar D., Singh S., *J. Ind. Coun. Chem*., 2009, 26, 23.
4. Kumar H., Chaudhary R., *Der Chemica Sinica*, 2010, 1(2), 55.
5. Bajpai P., Agrawal P. K., Vishwanathan L., *J. Sci. Indust. Res*., 1982, 41, 185.
6. Habib S. I., Baseer M. A., Kulkarni P. A., *Der Chemica Sinica*, 2011, 2(1), 27.
7. Rehman W., Baloch M. K. and Badshah A., Synthesis, Spectral Characterization and Bio-Analysis of Some Organotin(IV) Complexes. European Journal of Medicinal Chemistry, 43, (2008) 2380-2385.
8. Che C. and Huang J.S., Metal Complexes of Chiral Binaphthyl Schiff-Base Ligands and Their Application in Stereoselective Organic Transformations. Coordination Chemistry Reviews, 242, (2003), 97-113.
9. Singh B. K., Bhojak N. and Prakas A., *E-Journal of Chemistry*, 2012, 9(2), 532-544.
10. Soliman A. A., Mohamed G. G, *thermochim. Acta*, 2004, 421, 151.
11. Muller H. and Pechmann H. V., *J. chem. soc.*, (1890), 58, 51.
12. Oyedemi S.O., Bradley G. and Afolayan A.J. Anticabterial and Antioxidant Activities of Hydroalcoholic Stem Bark Extract of Schotia latifolia Jacq. Asian Pacific Journal of Tropical Medicine, 4, (2011) 952-958.
13. NCCLS/CLSI—National Committee for Clinical Laboratory Standards (2004) Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria that Grow Aerobically. Approved Standard 6th Edition: M07-A6, Clinical and Laboratory Standards Institute, Wayne, PA.
14. Morrison and Boyd (6th ed.), Organic Chemistry (Prentic Hall, Pvt. Ltd., 1997) 746.
15. Deshmukh R. G. and Thakkar N. Y., *Indian J. Chem.*1985 , 23A, 1066-1070.
16. Taylor T. W. J. and Ewbank E. K., *J. Chem. Soc.*1926, 2811-2815.
17. Talwar U. B. and Haldar B. C., *J.Inrog. Nucli. Chem.*1970, 32, 213-217.
18. Thakkar N. V. and Deshmukh R. G., *Indian J. Chem.*1994, 33A, 224-230.
19. Yamada S., *Coord. Chem. Review*, 2, (1967) 83.
20. Kelly W. S. J., Ford G. H. and Nelson S. M., *J.Chem.Soc.*, A, 388 (1971).