

Green synthesis of novel triazine and their metal complexes as potent antimicrobial agents

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ABSTRACT

Triazines hold a specific place among the great variety of nitrogen containing heterocyclic compounds. Metal complex of newly synthesized triazines demonstrate a large range antimicrobial activity. Synthesis of metal complex by green synthesis method by using microwave technique. Tridentate chelate complex of ML type [M= Cu (II), Co(II), Cr(II)] have been synthesized from triazine based ligand. Structures of the products have been deduced from their elemental analysis and spectral data (IR, ¹H-NMR, XRD). Select new synthesized compounds were screened as antimicrobial activity against *Escherichia coli*, *proteus mirabilis*, *staphylococcus aureas*, and *A. Niger* has been carried out and compared with standard one.

Keywords: Heterocyclic, Tridentate, Chelate, Antimicrobial Activity.

INTRODUCTION

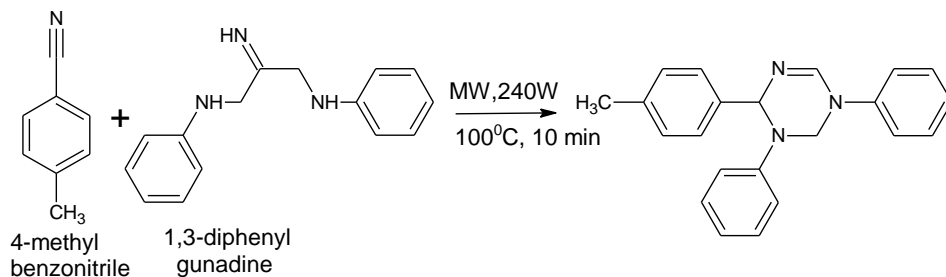
1,3,5-triazines, as key skeletons of many important bioactive heterocyclic compounds, frequently present in insecticides, fungicides, herbicides, antimalarial, antitumor and antivirals (Saleh *et al.* 2010, Patel *et al.*, 2011, Liu *et al.*, 2018). Meanwhile, due to their chemical properties, they are used in organic dyes, chelating ligands for synthesis organometallic materials, liquid crystals, electroluminescent materials and fluorescent brighteners (García *et al.* 2009, Kotha *et al.* 2008, Fischer *et al.* 2007). The chemical reactivity of 1,2,4-triazines depends on the type of nucleophile employed, stability of adducts of transition state, site selectivity, and the dielectric constant of solvent used (Tan *et al.* 2009, Sangshette *et al.* 2010, Nishimura *et al.* 2001, Heravi *et al.*, 1995, Abdel-Rahman, 1993;1986, Rykowski, A.; Vanderplas, 1987). In this paper we are synthesized 4-(4-methylphenyl)-1,3-diphenyl-1,2,3,4-tetrahydro-1,3,5-triazine as a ligand and their metal complex and their antimicrobial activity.

MATERIAL AND METHOD

2.1 Synthesis of ligand 4-(4-methylphenyl)-1,3-diphenyl-1,2,3,4-tetrahydro-1,3,5-triazine

4-methyl benzonitrile (10 mmol), 1,3-diphenylguanidine (10mmol) and the addition of ethanol. The mixture was microwaved at 100 °C for 10 min at 240 w. The completion of the reaction was checked by TLC. On completion the reaction mixture was cooled at room temperature and poured into ice cold water (50 ml). A solid separated out which was collected and washed with water (10 ml) and dried. The product was recrystallized by ethanol.

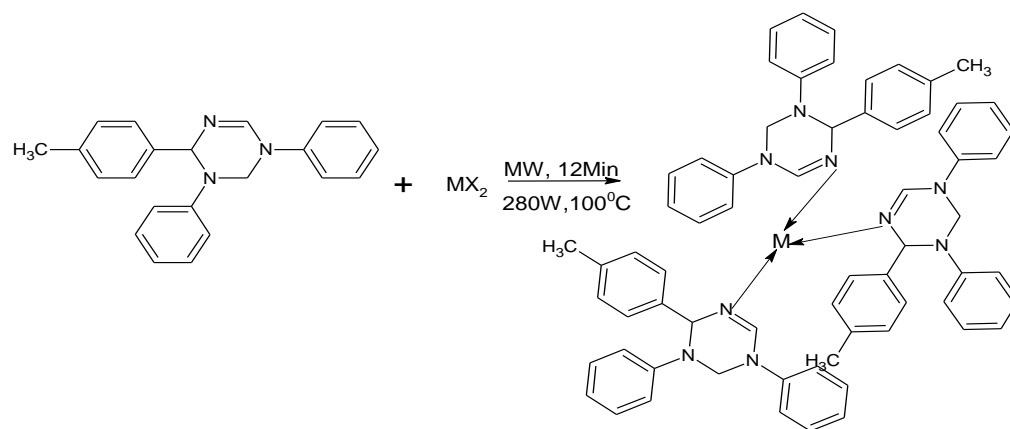
SCHEME I



2.2 Synthesis of metal complexes

An ethanolic solution of ligand 4-(4-methylphenyl)-1,3-diphenyl-1,2,3,4-tetrahydro-1,3,5-triazine and anhydrous metal salt MX_2 [$\text{M} = \text{Cu} (\text{II}), \text{Co} (\text{II}), \text{Cr} (\text{II})$] refluxed in microwave for 12 min., at 280 W 100 °C . The characteristics coloured complex precipitate was filtered washed with ethanol and dried in vacuum .

SCHEMEII



RESULTS AND DISCUSSION

Physical properties and analysis of ligand and its metal complex

Sr. no.	compound	Mol. formula	M.P.	%	Nitrogen analysis
1	Ligand	C ₂₂ H ₂₁ N ₃	123	78%	12.83%
2	Cu complex	C ₆₆ H ₆₃ CuN ₉	258	70%	12.05%
3	Co complex	C ₆₆ H ₆₃ CoN ₉	237	68%	12.11%
4	Cr complex	C ₆₆ H ₆₃ CrN ₉	214	72%	12.0%

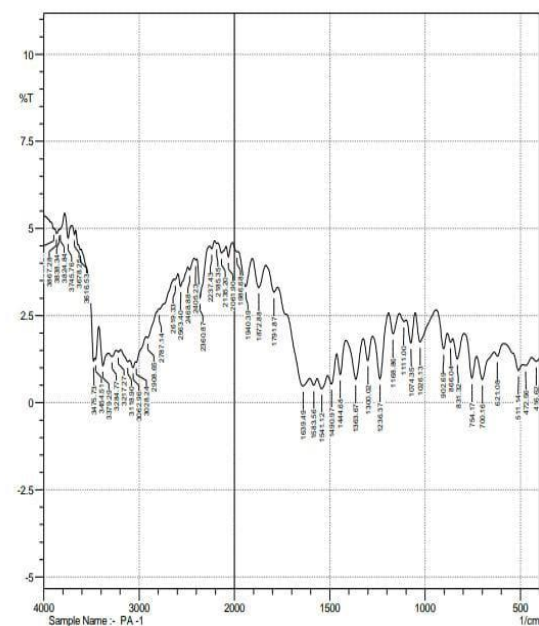
FTIR analysis:

IR anylysis for ligand: IR values of triazine are given in Table 3. The IR spectra of triazine exhibited that a new peak is revealed at 1603 cm⁻¹ which may be due to presence of stretching frequency of C=N. The C-N peak occurred at 3379 cm⁻¹. New peaks observed at 3028 cm⁻¹ due to sp² (C-H) stretching.

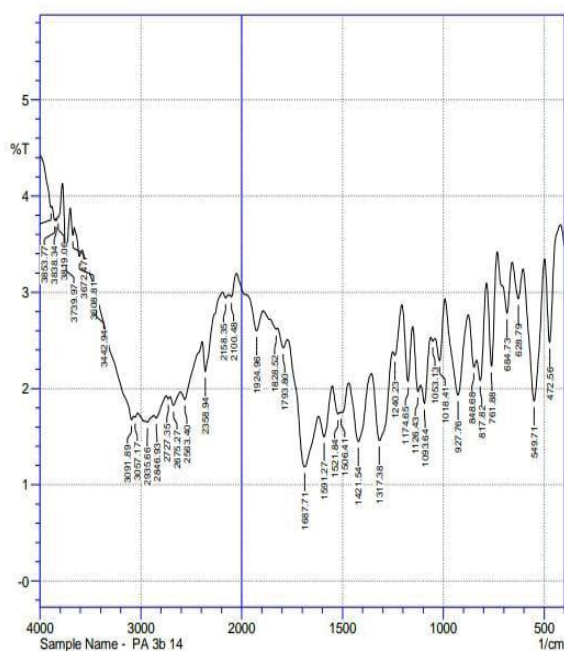
IR analysis for metal complex : IR values of metal complex are as follows . The IR spectra of metal complex exhibited that a new peak are revealed at 1603, 1593, 1592, 1596 cm⁻¹ , which may be due to presence of stretching frequency of C=N . The C-N peak occurred at 3330,3330,3260 cm⁻¹, which also suggests the development of the required compound. New peaks observed at 3028 ,3079 ,3040, 3062, cm⁻¹ due to sp² (C-H) stretching .

Compound	C-N	(C=N)	M-O	-CH=CH
ligand	3379	1603	-	3028
[Cu L ₃]	3330	1593	506	3079
[CoL ₃]	3330	1592	424	3040
[Cr L ₃]	3260	1596	416	3062

IR graph for ligand and metal complex



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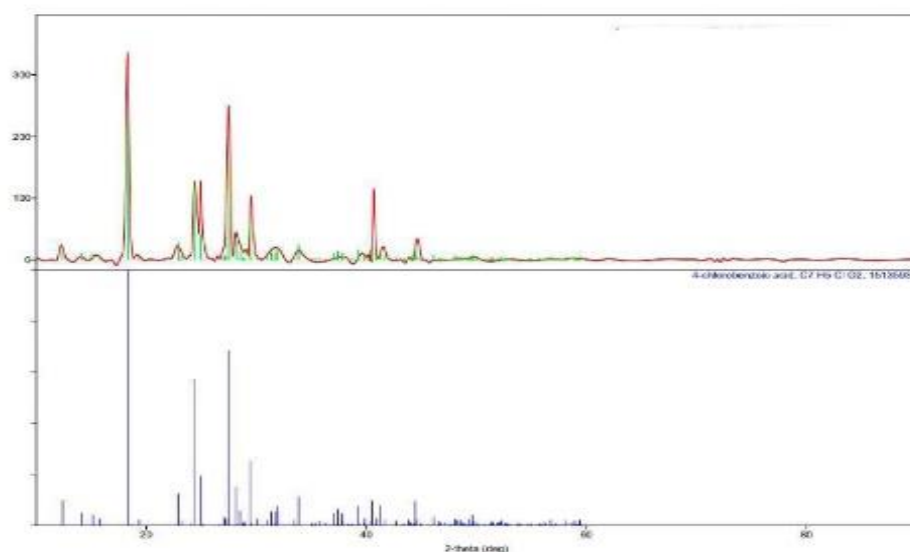


NMR analysis:

NMR study of ligand: (δ ppm) 3.10 -3.16(dd, 1H, H), 3.79-3.72(dd, 1H, H), 9.4 (s, C-NH, 1H) ,5.29-5.21 (dd, 1H, H), 6.6-8.6 (m, 10 Ar-H).

NMR study of Metal complex: (δ ppm) 3.10 -3.18(dd, 1H, H), 3.79-3.82(dd, 1H, H), 9.4 (s, C-NH, 1H) ,5.19-5.21 (dd, 1H, H), 6.6-8.7 (m, 10 Ar-H).

XRD analysis of metal complex: X-ray diffraction spectroscopy figure E and F analysis carried out. metal complex exhibited peak of 2 theta of copper complex 2theta is 19 radian peak at (112) and 2 theta of Cobalt complex 27 degree radian peak at (111) respectively. XRD analysis proved that complex have perfect crystalline structure.



XRD graph for metalcomplex

Antimicrobial Study:

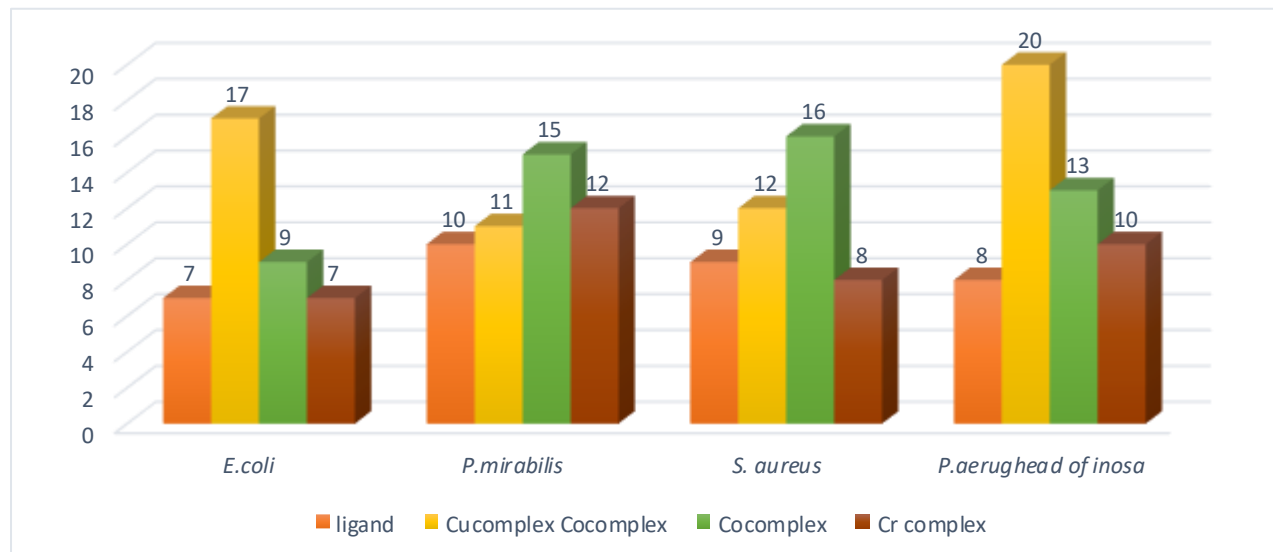
Above synthesized triazine and their metal complex have been studied for their antimicrobial activity against *Escherichia coli*, *Proteus mirabilis*, *Staphylococcus aureus*, *A. Nigar*. The culture of each species was incubated at 37 °C and the zone of inhibition was measured after 24 hr. Most of these compounds were found active.

Table 2: Antimicrobial activity

Sr. No.	Compound	Antimicrobial activity			
		<i>E.coli</i>	<i>P.mirabilis</i>	<i>S. aureus</i>	<i>P.aerughead of inosa</i>
1	Ligand	07mm	10mm	09mm	08mm
2	Cu Complex	17mm	15mm	12mm	14mm
3	Co Complex	09mm	16mm	16mm	13mm
4	Cr complex	07mm	12mm	08mm	10mm

Strongly active range: 15-18 mm, weakly active range : 7-10 mm

Moderately active range: 11-14 mm



CONCLUSION

Characterization of triazine and their metal complex are done by uv-visible, IR, ^1H NMR, XRD are done as explained in result and discussion. Thus from above result it was observed that the heterocyclic compound were found effective against *Escherichia coli*, *proteus mirabilis*, *staphylococcus aureas*, and *A. Niger* so all synthesized compound can easily be used for the treatment of disease caused by these above pathogen. Metal complex are more effective than ligand.

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Conflicts of interest: The authors stated that no conflicts of interest.

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