Research Article

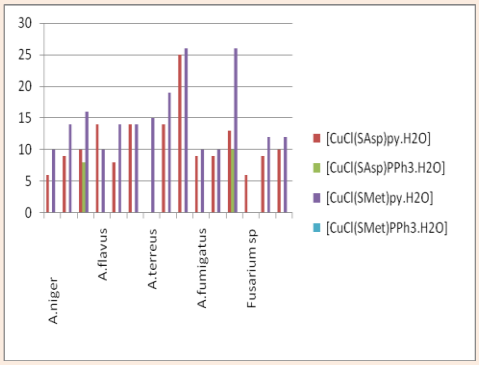
# Synthesis and Antimicrobial Evaluation of Copper (II) Complexes with some Amino Acids

K. Kiruthikajothi *[1], G. Chandramohan[2] and K. Muniyappan[1]

[1]Research and Development Centre, Bharathiar University, Coimbatore – 641 046
[2]Department of Chemistry, A.V.V.M. Sri Pushpam College, (Autonomous), Poondi, 613 503, Thanjavur, India

## Abstract

The copper Schiff base complexes with amino acids aspartic acid and methionine were synthesized. These synthesized complexes were subjected to in vitro anti fungal activity against Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Aspergillus fumigatus and Fusarium sp at different concentrations by using agar diffusion method. Among the tested complexes $[CuCl(SMet)py.H_2O]H_2O$ was found to have better inhibitory activity against all tested microbes at MIC 50 µl. $[CuCl(SAsp)py.H_2O]H_2O$ also showed significant activity against five fungal strains.




**Keywords:** Aspartic acid, agar diffusion method, fungal strains

***Correspondence**
K. Kiruthikajothi,
Email: k.kiruthikajothi@gmail.com

## Introduction

Microbial infection on human beings as well as on plants is becoming a global concern in recent years [1,2]. The microbes affect and cause various diseases with showing the symptoms like constipation, Diarrhoea, colitis, abdominal pain, head ache, bad breath, rectal itching, kidney and bladder infections and adrenal problems. There are numerous differences between bacteria metabolic targets and human host because bacteria are prokaryotic. But fungi are eukaryotes that are complicate to design the fungal agents only toxic to fungi not to host [3-5].

Schiff bases are known to their broad spectra of biological applications. Metal complexes containing Schiff bases aroused from nitrogen, sulfur and oxygen donor atoms exhibit anti – inflammatory activity, fungicidal, anti radical activity, insecticides and cytotoxicity activities [6-8]. Many researchers reported that fungicides containing nitrogen side chain showed good inhibition against the growth of several fungi. Ex: Fusarium in sweet potatoes.

Copper Schiff complexes are important bioactive compounds in vitro and vivo and used as potential drugs for therapeutic invention in various diseases. The objective of this work was to synthesize copper Schiff base complexes derived from salicylaldehyde and amino acids aspartic acid or methionine and evaluate their antifungal activities.

## Experimental

All the chemicals used were pure and analytical grade. Aspartic acid, methionine, salicylaldehyde, pyridine, triphenylphosphine, Cu(II) chloride dihydrate and common reagents such as NaOH, KOH, sodiumborohydride were purchased from Merck Specialties Private Limited.

**Preparation of ligands**

Aspartic acid or methionine (1.33 g or 1.49 g, 10 mmol) was dissolved in 10 mL distilled water with KOH (0.56 g, 0.01 M). Salicylaldehyde (1.22 g, 10 mmol) dissolved in 10 mL ethanol was added to amino acid solution and stirred for 3 h. The obtained yellow colour solution was cooled in an ice path. The intermediate Schiff base formed was reduced with 5 mL of sodiumborohydride (0.378 g, 10 mmol) containing few drops of NaOH solution. The yellow colour slowly discharged and the pH of the solution was adjusted to 3.5 – 6 using few drops of con HCl to obtain the solid precipitate. The obtained precipitate was then filtered and washed with ethanol and diethyl ether and allowed to dry completely at room temperature [9].

**Synthesis of copper (II) complexes**

Copper chloride dihydrate (1.70 g, 10 mmol) was dissolved in 15 mL ethanol. Pyridine or triphenylphosphine (0.79g or 2.62 g, 10 mmol) was dissolved in 10 mL ethanol and transferred to copper chloride solution. It was stirred for 10 minutes. The corresponding ligand (10 mmol) was dissolved in 10 mL distilled water with KOH (1 mL, 0.01M) was added to it and allowed to stir for 2h at room temperature. The reaction mass was filtered and allowed to evaporate at RT [9]. The synthesis scheme was represented by **Figure 1**.

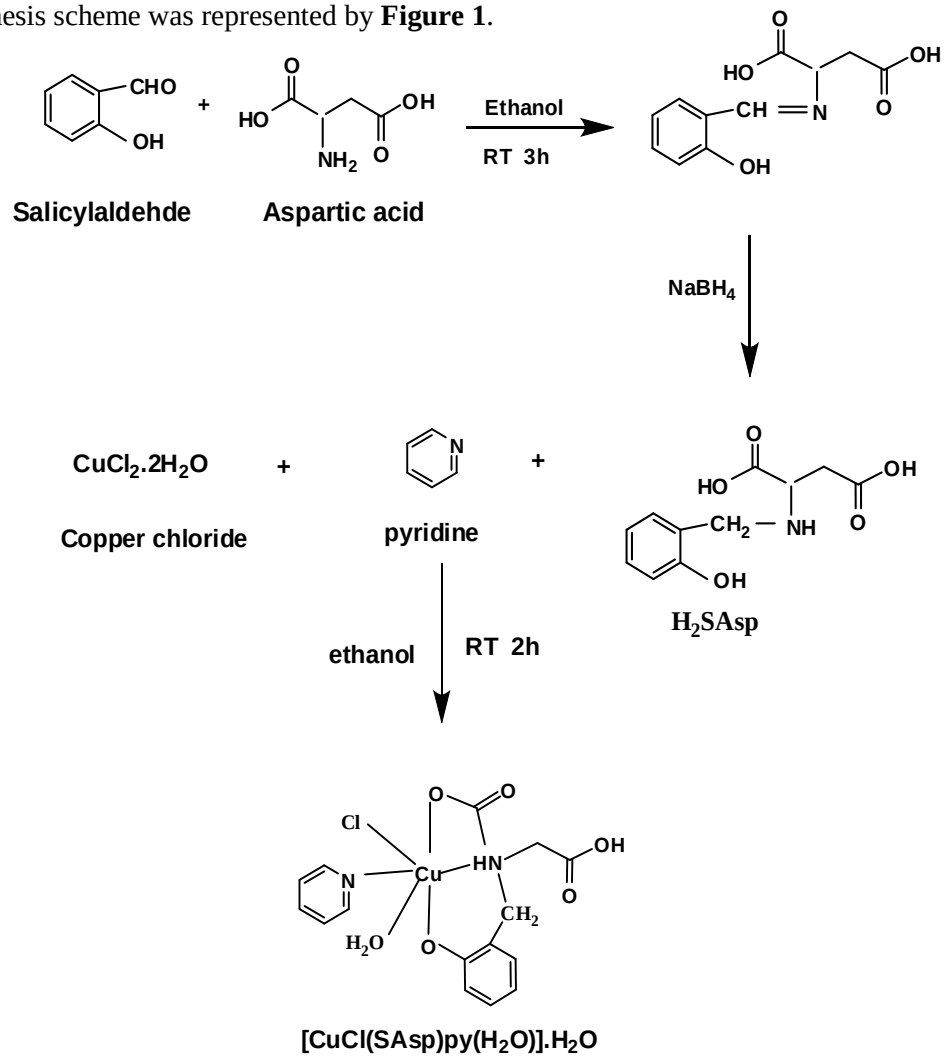



**Figure 1** Scheme for the synthesis of copper complex

**Anti fungal activity**
**Collection of fungal pathogen**

The fungal pathogens Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Aspergillus fumigatus and Fusarium sp were selected for testing anti fungal activity. The five fungal clinical isolates were collected from Vinodhagan hospital, Thanjavur.

**Preparation of test organism**

The anti fungal activity was determined by Agar well diffusion method. Potato dextrose agar plates were swabbed with 48 h broth culture of test organisms using sterile cotton swab. Three wells with 6 mm diameter were made in each of these plates using sterile cork borer. Using sterilized micro pipettes tips 50,100,150 µl and control were added in the wells and allowed to dispense at room temperature for 2 hours. Zone of inhibition in mm was recorded and illustrated in **Figure 3**.

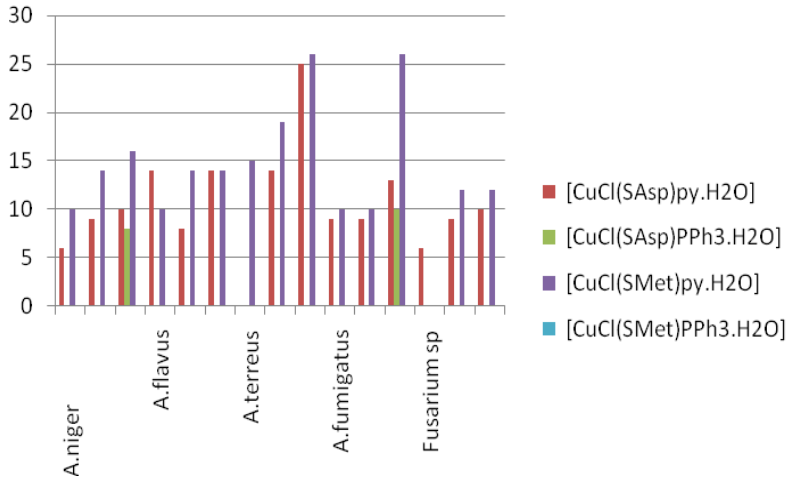



**Figure 2** Antifungal activity of Cu(II) complexes

## Results and Discussion

**Table 1** Antifungal activity of Cu(II) complexes**.**

Zone of inhibition (mm)

| S. No | Name of the complex | A. niger | | | A. flavus | | | A. terreus | | | A. fumigates | | | Fusarium sp | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 µL | 100 µ L | 150 µ L | 50 µ L | 100 µ L | 150 µ L | 50 µ L | 100 µ L | 150 µ L | 50 µ L | 100 µ L | 150 µ L | 50 µ L | 100 µ L | 150 µL |
| 1. | [CuCl(SAsp)py.$H_2O$] | 6 | 9 | 10 | - | 8 | 14 | - | 14 | 25 | 9 | 9 | 13 | 6 | 9 | 10 |
| 2 | [CuCl(SAsp)$PPh_3$.$H_2O$] | - | - | 8 | - | - | - | - | - | - | - | - | 10 | - | - | - |
| 3. | [CuCl(SMet)py.$H_2O$] | 10 | 14 | 16 | 10 | 14 | 14 | 15 | 19 | 26 | 10 | 10 | 26 | 10 | 12 | 12 |
| 4. | [CuCl(SMet)$PPh_3$.$H_2O$] | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 |
| 5. | Kanamycin | 25 | | | 29 | | | 37 | | | 21 | | | 18 | | |

The antifungal activities of synthesized complexes screened against Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Aspergillus fumigatus and Fusarium sp were presented in **table 1**. The results were compared with standard drug kanamycin.

The complex [CuCl(SAsp)py.$H_2O$] inhibited the growth of A.niger, A.fumigatus and Fusarium sp at MIC 50 µl. [CuCl(SAsp)Py.$H_2O$] exhibited anti fungal activity against A. flavus and A. terreus at MIC 100 µl while [CuCl(SAsp)$PPh_3$.$H_2O$] was inactive against these pathogens.[CuCl(SMet)Py.$H_2O$] showed good inhibitory effect against all tested organism. From the results it was found that copper pyridine complexes showed better activity that copper triphenylphosphine complexes. [CuCl(SAsp)$PPh_3$.$H_2O$] and [CuCl(SMet)$PPh_3$.$H_2O$] showed minor activity against A. niger, A.fumigatus and fusarium sp respectively at 150 µl. [CuCl(SAsp)py.$H_2O$]inhibited the growth of all tested organism to a considerable extent.

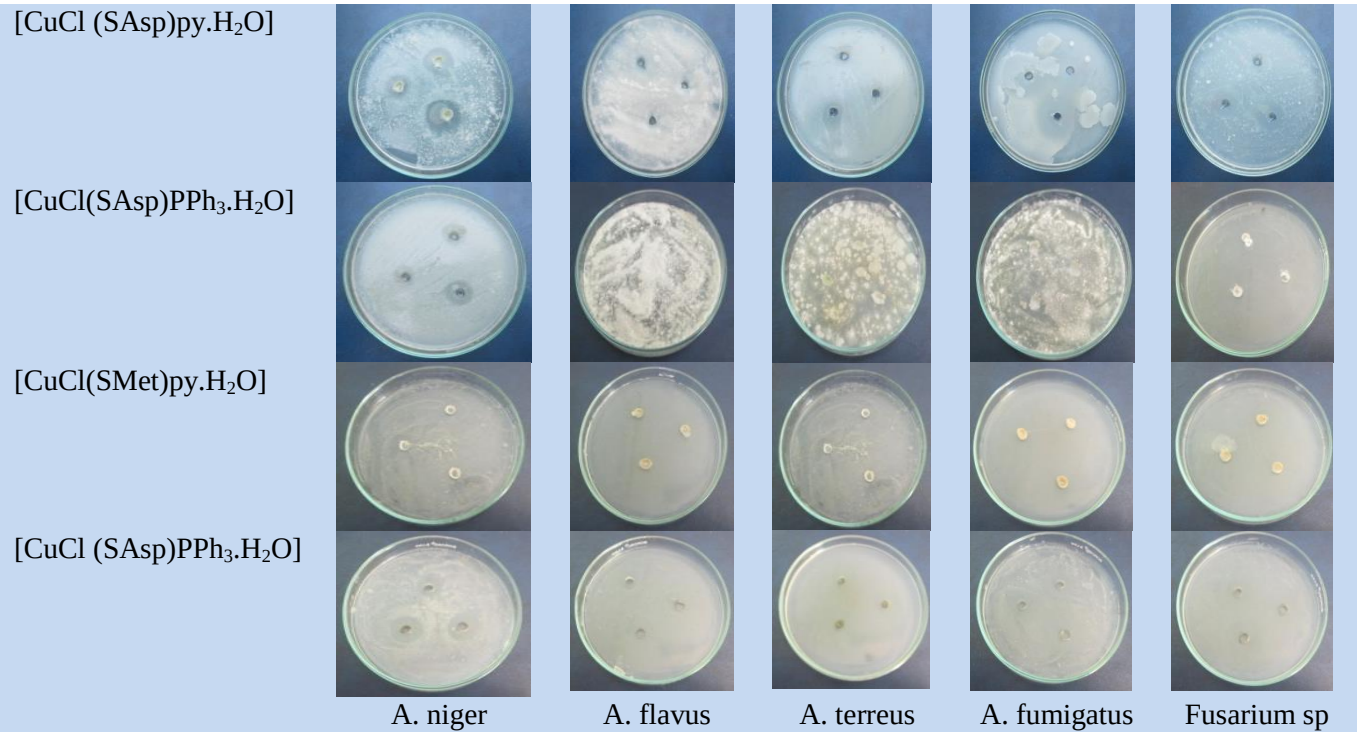



**Figure 3** Antifungal activities of copper complexes at 50,100,150 µl concentrations

## Conclusions

Copper metal complexes [CuCl(SAsp)py.$H_2O$], [CuCl(SAsp)$PPh_3$.$H_2O$], [CuCl(SMet)py.$H_2O$] and [CuCl(SMet)$PPh_3$.$H_2O$] have been synthesized and screened for their in vitro antifungal activity against Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Aspergillus fumigatus and Fusarium sp. [CuCl(SAsp)py.$H_2O$] and [CuCl(SMet)py.$H_2O$] showed significant antifungal activity compared to other tested triphenylphosphine complexes.

## References

[1] Abha Bishnoi, Surchi Singh, A.K. Tiwari, Archana Rani, Sapna Jain, C.K. M. Tripathi, Synthesis and antimicrobial activity of some new 1, 2, 4-triazine and benzimidazole derivatives, Indian Journal of Chemistry, **2014**, 53B, 325-331

[2] S. Saha, D. Dhansekaran, S. Chadraleka, A. Panneerselvam, Synthesis,characterization and antimicrobial activity of cobalt metal complex against multidrug resistant bacterial and fungal pathogens, Physics, Chemistry and Technology,**2009**,7,73-80

[3] B. Cornelia, A. Stanila, M. A. Rotar, M. Petran, C. Socaciu, Antifungal activity of some aminoacids complexes againt candida albicans, Buletin USAMV- CN, **2006**,62, 207-212.
[4] L. Tapia, M. Gonzalez-Aguero, F. Cisternas, M. Suazo, M. Gonzales, Metallothionein is crucial for safe intracellular copper storage and cell survival at normal and supra- physiological exposure levels, Biochem.J., **2004**,378, 617-624.
[5] V. Vidotto, B. Mantoan, A. Pugliese, J. Ponton, G. Quindos,S. Ito Kuwa,Candida dubliniensis versus Candida albicans adhesion and biofilm formation, *Rev. Iberoam Micol*., **2000**, 20, 52-54.
[6] R. Katwal, H. Kaur, B.K. Kapur, Applications of copper-Schiff's base complexes: A review, Sci. Revs. Chem. Commun., **2013**, 3(1),1-15.
[7] R. Prabhakaran, A. Geetha, M. Thilagavathi, R. Karvembu, Venkata Krishnan, Helmut Bertagnolli, K. Natarajan, Synthesis,characterization,EXAFS investigation and antibacterial activities of new ruthenium(III) complexers containing tetradentate Schiff base, Journal of Inorganic Biochemistry,**2004**,98,2131- 2140.
[8] R. Elayaperumal, M. Kiruthika, P. Dharmalingam, In-vitro antioxidant and antimicrobial studies of mixed ligand copper (II) complexes of benzimidazolyl terpyridine, Chem Sci Rev Lett, **2014**, 2(5), 369-375.
[9] K. Kiruthikajothi, G. Chandramohan, S. Chandraleka, Synthesis and larvicidal activity of copper complexes containing amino acid and pyridine/triphenylphosphine, Int J Curr Res, **2013**, 5(11), 3419-3421.



Publication History
Received 14th June 2014
Revised 20th June 2014
Accepted 22nd June 2014
Online 29th June 2014