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Antimicrobial activity of salicylaldimine Schiff bases

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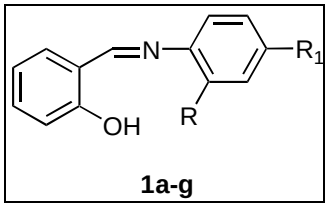
Abstract: The present research article describes the study of antimicrobial activity of salicylaldimine Schiff base. Compounds containing an azomethine group (-CH=N-), known as Schiff bases are formed by the condensation of a primary amine with carbonyl compounds. Schiff bases are very important in medicinal and pharmaceutical fields because of their wide spectrum of biological activities. Most of them show biological activities such as antibacterial, antifungal as well as antitumor activity. The salicylaldimine derivatives **1a**, **1c**, **1d** exhibited significant antibacterial and antifungal activity.
Key words: antifungal, schiff bases, antibacterial.

Introduction

Infectious diseases are disorders caused by pathogenic microorganisms like bacteria, viruses, fungi and protozoa. Bacterial diseases are a type of infectious diseases caused by pathogenic bacteria. Bacterial infections are one of the prominent causes of health problems, physical disabilities and mortalities around the world.[1] Due to the rapid bacterial resistance to antibacterial agents; it leads to discover novel and new antibacterial agents of either natural or synthetic origin to battle against pathogenic microorganisms. Schiff bases possess biological properties like antibacterial,[2-6] antifungal,[7-10] pesticidal,[11] antiinflammatory[12] and antiviral.[13]

Schiff bases of salicylaldehydes have also been reported as plant growth regulators,[14] antimicrobian[15] and antimycotic[16] activity. Schiff bases also have some analytical applications[17] viz., preparative use, identification, detection and determination of aldehydes or ketones, purification of carbonyl or amino compounds, or protection of these groups during complex or sensitive reactions.

In this paper we have discussed the antimicrobial activity of some novel salicylaldimine Schiff bases of biological significance. The Schiff bases (**1a-g**) are synthesized from salicylaldyhde and derivatives of aromatic amines under microwave condition[18] (**Fig.1**). Antimicrobial activity was performed by using cup-plate agar diffusion method against ten bacteria and ten fungi strains.



1a-g

Fig. 1 1a R = COOH, R_1 = H 1b R = H, R_1 = Cl 1c R = H, R_1 = NO_2 1d R = H, R_1 = CH_3 1e R = H, R_1 = OCH_3 1f R = CH_3, R_1 = H 1g R = OCH_3, R_1 = H

Experimental

Schiff bases melting points (mp) were determined using Boetieus micro heating table and are uncorrected. All chemicals used were of A.R purchased from Merck.

Salicyaldimine Schiff bases (**1a-g**) were synthesized by the reaction of salicyladehyde and various aniline derivatives under microwave irradiation. The structures of the target compounds were well characterized by IR, ^{1}HNMR, ^{13}CNMR and MS Spectra.[18]

Antibacterial activity

Antibacterial screening was determined based on the cup plate agar diffusion method by measuring a clear zone of inhibition in millimeters.[19,20] All the samples were tested at a concentration of 500 / 1000 µg/mL in DMSO. The bacterial strains employed were *Escherichia coli, Pseudomonas aeurginosa, Bacillus subtilis* and *Klebsiella aerugenes*. The antibacterial activity was carried out, by using standard reference drugs Clotrimazole (10 µg/mL) and Ofloxacin (5 µg/mL).

Antifungal activity

Antifungal activities of each compound were evaluated by the agar disc-diffusion method. Sabarod's agar media (15 cm^3) kept at 45^{o}C was poured in the petri-dishes and allowed to solidify. Sterile, filter paper discs of 10 mm diameter were impregnated with prepared Schiff bases (50 µL) and were placed to the media, seeded with fungus. The plates were then incubated at 27^{o}C for 72 hr. At the end of period the inhibition zones formed on media were measured with a zone reader in millimeters. The fungal strains used were *Aspergillus niger, Aspergillus flavus, Rhodoforula rubra* and *Candida albicans.* Clotrimazole (10 µg/mL) and Ofloxacin (5 µg/mL) were used as standard reference drugs for antifungal activity.[20,21]

Minimum inhibitory concentration (MIC) of the compounds was also estimated by broth dilution assay [21] for the microorganisms, which were determined as sensitive to the compounds in disc-diffusion assay. Nutrient broth (NB) and Sabouraud's dextrose broth (SDB) were used to estimate the MIC values of the test compounds against bacteria and fungi respectively. A two fold serial dilution of test compounds were followed with 1ml of sterile broth in test tubes to provide various concentration ranges from 3.9-1000 µg/ml of the test compounds. Ten µl of the test organism was added to each tube and incubated at 37˚ C for 24 hr and 27˚ C for 72 hr for bacteria and fungi strains respectively. The highest dilution of the test compound completely inhibiting the test organism was considered as MIC value of the test compound respectively.

Results and Discussion

In the present investigation, study of microbial activity of synthesized Schiff base salicyaldimine derivatives. The results of the antibacterial activity of the compounds tested against selected organisms are listed in **Table 1**. The compounds **1a** and **1c** showed maximum activity against *Klebsiella aerugenes* (13 mm) and *Pseudomonas aeruginosa* (13 mm).

Table 1: *In vitro* antimicrobial activity of 1a-g

Microorganisms	Diameter of zone of inhibition in mm																	
	1a µg/disc		1b µg/disc		1c µg/disc		1d µg/disc		1e µg/disc		1f µg/disc		1g µg/disc		A µg/disc	B µg/disc
	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000	500	1000	5	10
Escherichia coli (NCIM 2065) [a]	-	-	8	11	7	8	-	9	8	9	-	9	-	10	23	NT
Pseudomonas aeruginosa (NCIM 2200) [a]	10	13	-	12	10	11	7	10	-	10	-	9	7	10	22	NT
Bacillus subtilis (NCIM 2063) [a]	-	9	10	13	9	12	7	10	-	9	11	12	7	12	24	NT
Klebsiella aerogenes (NCIM	11	13	7	10	11	13	7	8	-	9	-	-	7	10	21	NT

2239)[a]																
Aspergillus niger (NCIM 1196) [b]	-	-	8	10	7	9	-	-	8	12	-	-	-	10	NT	16
Aspergillus flavus (NCIM 535) [b]	-	10	9	11	9	12	10	12	9	13	-	9	8	10	NT	16
Rhodotorula rubra (NCIM 3174) [b]	9	12	7	10	-	-	-	8	8	10	7	11	-	10	NT	17
Candida albicans (NCIM 3471) [b]	9	10	9	10	10	13	11	13	9	11	9		9	11	NT	18

[a] bacteria [b] fungi ; A = Ofloxacin, B = Clotrimazole, - No inhibition, NT- Not Tested

The results of antifungal activity of the compounds tested against selected organisms are listed in **Table 1.** While all the test compounds showed significant antifungal activity, the compounds **1c** and **1d** showed good antifungl activity against *Candida albicans* and *Aspergillus flavus*; and the compound **1e** exhibited good antifungal activity against *Aspergillus niger*.

Minimum inhibitory concentration (MIC) of the compounds was also estimated by broth dilution assay method. The results of the MIC values of the compounds are listed in **Table 2**. The MIC values of the compounds range between 7.8 and 125 µg/mL in most of the cases.

Table 2: Minimum Inhibitory Concentration values of 1a-g (µg/mL)

Microorganisms	**1a**	**1b**	**1c**	**1d**	**1e**	**1f**	**1g**
Escherichia coli (NCIM 2065) [a]	-	62.5	125	-	62.5	-	125
Pseudomonas aeruginosa (NCIM 2200) [a]	7.8	125	15.6	-	62.5	-	62.5
Bacillus subtilis (NCIM 2063) [a]	-	31.2	125	62.5	-	125	62.5
Klebsiella aerogenes (NCIM 2239) [a]	7.8	125	15.6	125	-	-	62.5
Aspergillus niger (NCIM 1196) [b]	-	125	125	-	62.5	-	-
Aspergillus flavus (NCIM 535) [b]	-	125	125	31.2	-	62.5	125
Rhodotorula rubra (NCIM 3174) [b]	62.5	125	-	-	125	62.5	-
Candida albicans (NCIM 3471) [b]	125	125	7.8	7.8	62.5	-	62.5

[a] bacteria [b] fungi; - Not Tested

Conclusions

In this article, we are demonstrating biological importance of Salicyaldimine derivatives. Schiff base of salicyaldimine derivatives exhibited moderated activities against both bacteria and fungi strains.

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