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INVESTIGATION OF ANTIMICROBIAL PROPERTIES OF SOME SCHIFF BASES

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Abstract: Schiff bases; 3-(2-hydroxy-1-salicylaldimine)-5-amino-4-(3-nitro-phenylazo)-1Hpyrazole (**3N-sal**), 3-(2-hydroxy-1-salicylaldimine)-5-amino-4-(3-bromo-phenylazo)-1Hpyrazole (**3Br-sal**), 3-(2-hydroxy-1-naphtaldimine)-5-amino-4-(3-nitro-phenylazo)-1Hpyrazole (**3N-naf**) and 3-(2-hydroxy-1-naphtaldimine)-5-amino-4-(3-bromo-phenylazo)-1Hpyrazole (**3Br-naf**) were synthesized by the condensation of some azo-pyrazole diamines with aromatic aldehydes at the same rate. The chemical structures of these compounds were elucidated using molecular spectroscopy methods. The antimicrobial proporties of schiff bases were investigated against bacteria.

Keywords: Schiff base; azo-pyrazole; antimicrobial activity; well diffusion method.

INTRODUCTION

The azomethine group (–N=CH–) is used to explain important reaction mechanisms in biological systems (Gao et al. 2002; Balsells et al. 1998; Sharghi & Nasseri 2003). It is known that Schiff bases are used as role models in elucidating some diseases. Therefore, its biochemical and pharmacological properties should be elucidated. (Datte et al. 2002; Archu & Wang 1990; Chang et al. 1998). Additionally, its important roles such as metal-bound protein and catalysis were also examined (Ünaleroğlu et al. 2001; Mohammed et al. 2006).

In continuation of our studies on the synthesis of heterocyclic structures we report here on new azomethines containing in the structure functionalized azo-pyrazole ring.(Uzun et al. 2021;Aydin et al. 2023). The compounds obtained are polydental ligands for designing metal complex catalysts, models for conformational isomerism and of new types of intramolecular and intermolecular effects, and also initial material for the synthesis of the pharmaceuticals (Turan et al. 2008; Baiklova et al. 2001; Ünlü et al. 2023).

Nitrogen heterocyclic has been used to treat biological disorders such as epilepsy. These compounds have received much attention in the medical field due to their ease of production. Pyrosols were found to have many antimicrobial activities (Salih 2008).

In this study, the synthesis and antibacterial activities of some Schiff bases were examined. 3,5-diamine-4-(3-bromo-phenylazo)-1Hpyrazole and 3,5-diamine-4-(3-nitro-phenylazo)-1Hpyrazole with aromatic aldehydes. The structure of Schiff bases was determined using elemental analysis. The antimicrobial properties of schiff bases were screened against bacteria.

EXPERIMENTAL

Materials and Methods

3,5-diamine-4-(3-bromo-phenylazo)-1Hpyrazole and 3,5-diamine-4-(3-nitro-phenylazo)-1Hpyrazole was synthesized as described earlier. 2-hydroxy-1-salicylaldehyde, 2-hydroxy-1-naphtaldehyde were purchased from Aldrich. Elemental analyzes were done with analytikjena brand mulitiEA and compEact model, FT-IR spectra were made with Jaeco brand FT-IR 4000 model. NMR spectra were taken with a JEOL ECZ500R (11.75 Tesla) device.

Synthesis of Schiff Bases

The hot solution of azo-pyrazole diamine (40 °C) in sufficient methanol was mixed with the hot solution of the aromatic aldehyde; Approximately 0.02 moles of 2-hydroxy-1-salicylaldehyde, 2-hydroxy-1-naphthaldehyde were mixed and added to dilute HAc solution and left under reflux for 5 hours at pH=5-6. Solid products were filtered. It was purified in the appropriate solvent. After washing, it was dried in vacuum. (Sharghi & Nasseri 2003). Found(calculated)(%): 3N-sal:C:54.93(54.70), H:3.49(3.70), N:28.24(27.92); 3Br-sal: C:50.14(49.88), H:3.46(3.38), N:22.06(21.82); 3N-naf: C:60.31(59.85), H:3.76(3.74), N:24.54(24.44); 3Br-naf: 55.53(55.19), H:3.58(3.45), N:19.42(19.31).

Procedure for Antibacterial Activities

Antimicrobial properties of schiff bases were tested against the bacteria. The solution of Schiff bases was prepared at the concentration of 20 mg/mL by using 10% DMSO solution. At general procedure (Mandal et al. 2008). Mueller Hinton-Agar was placed in petri plates. The solution of Schiff bases was added to the wells in the plates and left for 24 hours. Bacteria grew under the influence of the solutions. Their inhibition zone was measured with 10% DMSO solution. Experiments were performed under identical conditions for each bacterium. The diameter of the resulting inhibition zone, both antimicrobial activities, was calculated (Nartop et al. 2008).

RESULTS AND DISCUSSION

The chemical structures of schiff bases synthesized using the experimental process are given in figure 1. Molecular spectroscopy methods were applied to confirm the chemical structures of these compounds.

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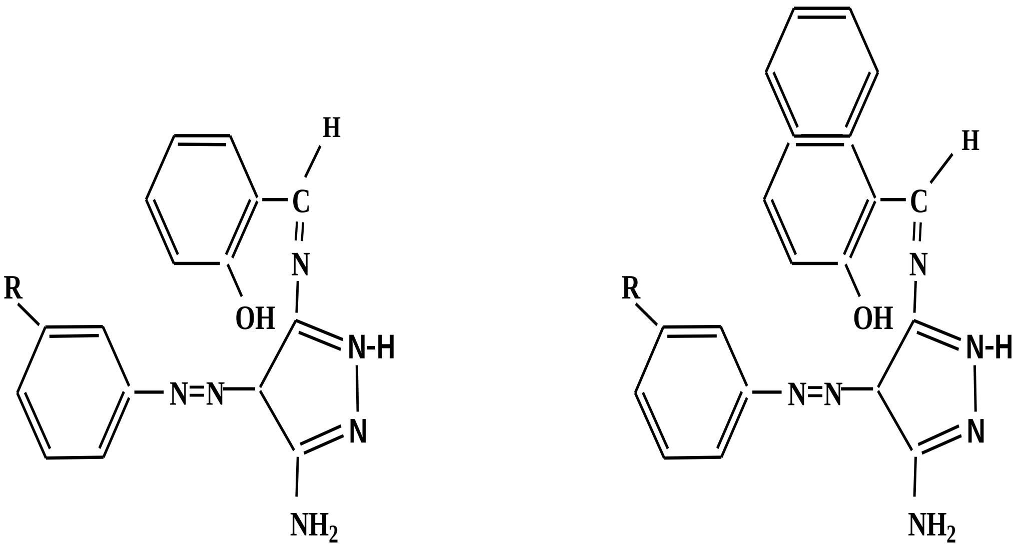

R=NO_2, **3N-sal**
R=Br, **3Br-sal**

R=NO_2, **3N-naf**
R=Br, **3Br-naf**

Figure 1. *The structure of Schiff bases*

NMR Spectra

NMR spectra of schiff bases were recorded in DMSO solution using TMS as internal Standard (Turan et al. 2008; Hamurcu et al. 2016). The chemical shifts of schiff bases are listed in Table 1. In ^{1}H-NMR spectra, the multiplates observed between 8.16-6.95 ppm are assigned to aromatic ring protons. The phenolic–OH appear between 14.49-12.87 ppm, pyrazole–NH between 12.16-11.41 ppm and pyrazole-NH_2 between 7.52-6.97 ppm broadly. The sharp singlet between 9.42-9.02 ppm corresponds to (–CH=N–) proton. In ^{13}C NMR spectra, azomethine (**C**H=N) and pyrazole (**C**=N) carbons are observed at 156.14 ppm and 149.21 ppm for **3N-sal**, 155.23 ppm and 149.29 ppm for **3Br-sal**, 154.39 ppm and 149.30 ppm for **3N-naf**, 153.76 ppm and 148.535 ppm for **3Br-naf.**

***Table 1**. The ^{1} H- NMR data of schiff bases in DMSO (as chemical shift, ppm)*

Compound	**OH**	**NH_2**	**NH**	**CH=N**	**Aromatic protons**
3N-sal	13.20 (1H,br)	7.52 (2H,br)	12.16 (1H,br)	9.46 (1H,s)	8.59(1H,t), 8.16(2H, dd), 7.76(2H, m), 7.65(1H, dd), 7.01(2H,dd)
3Br-sal	12.87 (1H,br)	7.07 (2H,br)	11.61 (1H,br)	9.42 (1H,s)	7.96(1H,t), 7.74(2H, dd), 7.46(2H, m), 7.44(1H, dd), 7.00(2H,dd)
3N-naf	14.26 (1H,br)	6.97 (2H,br)	11.41 (1H,br)	9.03 (1H,s)	8.69(1H,s), 8.32(1H,s), 8.16(2H,m), 7.92(1H, d), 7.79(2H, t), 7.55(1H, t), 7.36(2H,t)
3Br-naf	14.26 (1H,br)	7.05 (2H,br)	11.41 (1H,br)	9.03 (1H,s)	8.14(1H,d), 8.07(1H,s), 7.94(2H,d), 7.77(1H,d), 7.56(1H, m), 7.50(2H, m), 7.36(1H, t), 6.98(1H,d)

(*br: broad, s:singlet; d:dublet; dd:dublet in dublet; t:triplet; m:multiplet)*

FT-IR Spectra

FT-IR spectra of Schiff bases are found to be very similar to each other because of the same functional groups in the molecules. FT-IR spectra are given in figure 2. The sharp bands between 1618-1605 cm^{-1} are assigned to the ν(C=N) and the strong bands between 1334-1317 cm^{-1} are assigned to *v*(N=N) group. Weak peaks in 741-713 cm^{-1} are due to the C–H aromatic rings and broad peaks in the 3412-3285 cm^{-1} are due to the NH and NH_2 stretching vibrations belong to pyrazole ring (Nartop et al. 2008). These main vibration frequencies of Schiff bases are listed in Table 2. (A:3Br-sal, B:3Br-naf, C:3N-sal, d:3N-naf)

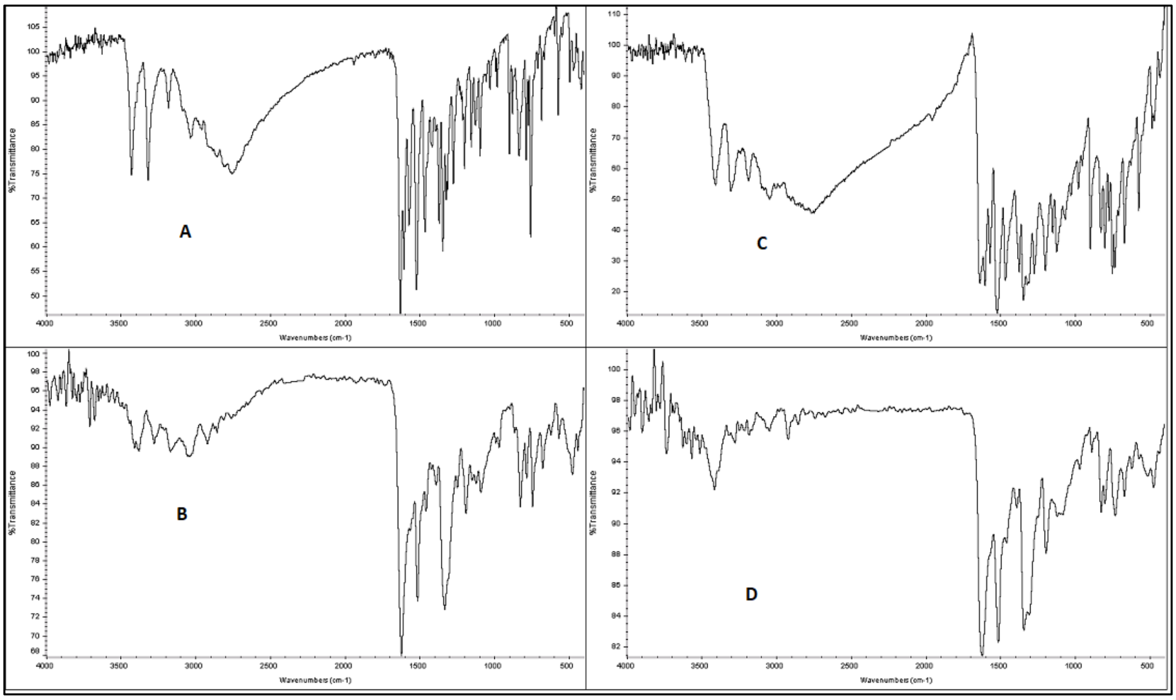

Figure 2. FT-IR spectra of 4 different Schiff bases

Table 2. *The main FT-IR vibration frequencies of Schiff bases (cm^{-1})*

Compound	**υ (NH_2)**	**υ (NH)**	**υ $(CH)_{arom.}$**	**υ $(CH)_{alph.}$**	**υ (C=N)**	**υ (C=C)**	**υ (N=N)**	**υ (C-O)**	**υ $(CH)_{ring}$**
3N-sal	3400(br)	3293(br)	3046(w)	2928(w)	1605(s)	1502(s)	1325(s)	1184(m)	713(w)
3Br-sal	3412(br)	3298(br)	3039(w)	2915(w)	1609(sh)	1510(s)	1317(s)	1194(w)	741(w)
3N-naf	3407(br)	3300(w)	3052(w)	2926(w)	1612(sh)	1503(s)	1334(s)	1208(m)	726(w)
3Bqr-naf	3384(br)	3285(br)	3067(w)	2921(w)	1619(sh)	1510(s)	1328(s)	1203(w)	734(w)

Antimicrobial Activities

The results of antimicrobial activity tests of the newly prepared compounds summarized in Table 3 could are determined due to the solubility (DMSO) of the compounds in the testing medium. Generally, most of the compounds have almost an antimicrobial activity. These compounds may be used purpose of treatment in medical processes as similarity investigations (Hamurcu et al. 2008; Cete et al. 2008).

Table 3. *Antimicrobial action zones of different microorganism.*

Microorganism			**Compounds**			
			3N-sal	3Br-sal	3N-naf	3N-naf
Bacterial Cells	Escherichia coli ATCC 11230	**Inhibition zone (mm)**	11	--	9	14
	Bacillus cereus (RSKK 863)		--	--	8	8
	Micrococcus Luteus		--	8	--	--
Yeast Cells	*Candida albicans* ATCC 10239		11	4	19	14

CONCLUSION

In conclusion, a series of schiff bases were synthesized and its structural were identified. Compounds have an antimicrobial properties. This means that the studied compounds may play an active role in the production of drugs that will treat some diseases. It can enable living beings to overcome the diseases they suffer from. They can also enable the production of compounds that are large and seemingly difficult to synthesize.

Conflict of interest

We would like to declare that there is no opposing view or existing conflict in this study.

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