

Microwave Synthesis and Biological Activity of some Schiff Base Derives

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Abstract

The organic compounds (L1–L7) have been synthesized by microwave and investigated by different physicochemical techniques. The resulting of the ligands were characterized by FTIR, UV/visible electronic spectra. The Schiff base may be acts as bidentate, tridentate or teradentate ligand, coordinated through deprotonated oxygen or/and azomethine nitrogen atom. The ligands were assayed for antibacterial activity against some pathogenic bacteria: *Staphylococcus aureus* (gram positive), and *Pseudomonas aeruginosa* (gram negative), using paper disc method and placing the ligands on surface at nutrient agar. The results show that the L2 and L3 have higher activities rather than other in both lower and higher concentrations against both kind of bacteria *Pseudomonas aeruginosa* respectively.

Introduction

Azomethine group ($-C=N-$) containing compounds typically known as Schiff bases have been synthesized by the condensation of primary amines with active carbonyls. Schiff bases form a significant class of compounds in medicinal and pharmaceutical chemistry with several biological applications that include antibacterial [1–2], antifungal, and antitumor activity [3,4], also have uses as liquid crystals, and in analytical [2,3], medicinal [4], and polymer chemistry [5]. They have been studied extensively as a class of ligands [6]. The literature reveals that the Schiff base ligands are excellent coordinating ligands through the azomethine nitrogen atom [7]. The study of mixed ligands formation were relevant in the field of analytical chemistry, where the use of mixed ligand allows the development of methods with increased selectivity, sensitivity and has also great important in the field of biological and environment chemistry [8]. The pharmacological activities have been found to be highly dependent on the nature of the donor sequence of the ligands, different ligand shows different biological properties, though they may vary only slightly in their molecular structure [9]. Conventionally Schiff bases have been prepared by refluxing mixtures of the amine and the carbonyl compound in an organic solvent, for example, ethanol or methanol [6], In general, ketones react more

slowly than aldehydes and higher temperatures and longer reaction times are often required as a result [10]. In addition, the equilibrium must often be shifted, usually by removal of the water, either azeotropically by distillation or with suitable drying agents [11]. In recent years, environmentally benign synthetic methods have received considerable attention and some solvent-free protocols have been developed [12]. Grinding together solid anilines and solid benzaldehydes yielded various kinds of benzylidene anilines [13]. The synthesis of imines by condensation of 2, 4, 6-trihydroxyacetophenone with amine derivatives under solvent free conditions [14]. Based on these facts, we decided to synthesize some Schiff bases derivative from primary amine derivatives and carbonyl derivatives in microwave irradiation and elucidate their biological activity on some pathogenic bacteria.

Chemicals and Instrumentals

1. Chemicals:

All chemicals and solvents used were analytical grade from Merck Company and BDH Company.

O-phenylenediamine, p-phenylenediamine, 4-amino 3-hydroxy naphthylsulfonic acid, 4-aminoantipyrine, butanoxim edione, benzyl hydroxide, 2,4,6-trihydroxyacetophenone, binzil, 2-hydroxy-1,2-diphenylethyl 2-one, ethanol absolute.

2. Instrumentals:

Ceramic mortar–China, Micro–wave Oven Russell hobbs 850 watt–China, Melting point–Gallenkamp M.F.B–600 F melting point apparatus, FTIR spectra using FTIR–8400S Shimadzu in the range of 4000–400 cm^{-1} , UV/VIS–1650 PC Shimadzu spectrophotometer, at wavelength (200–1100) nm.

Methods Preparation of Schiff base ligands.

The ligands were mixed from starting materials in ceramic mortar for 6 minutes according to following weights:

1. L1 was prepared by mixed 0.25 g of 2,4,6–trihydroxy–acetophenone and 0.08 g of o–phenylenediamine, then placed in a microwave for 2 minutes.
2. L2 was prepared by mixed 0.25 g of 2,4,6–trihydroxy–acetophenone and 0.08 g of p–phenylenediamine, then placed in a microwave for 2 minutes.
3. L3 was prepared by mixed 0.25 g of 2–hydroxy–1,2–diphenyl ethyl 2–one and 0.06 g of hydrazine dihydrochloride, then placed in a microwave for 25 minutes.
4. L4 was prepared by mixed 0.25 g of benzil and 0.13 g of hydrazine dihydrochloride, and then placed in a microwave for 2 minutes.
5. L5 was prepared by mixed 0.13 g of o–phenylenediamine and 0.25 g of butanoximedione, then placed in a microwave for 2 minutes.
6. L6 was prepared by mixed 0.13 g of p–phenylenediamine and 0.25 g of butanoximedione, then placed in a microwave for 2 minutes.
7. L7 was prepared by mixed 0.56 g of 4–amino–3–hydroxy–naphthyl–sulfonic acid and 0.25 g of butanoximedione, then placed in a microwave for 25 minutes.

All products were wash with 1:1 (ethanol: ether) and crystallized from ethanol and dried at 70 °C.

Results and Discussion

In this paper, we describe the synthesis of Schiff base was formed in good yield; the organic compound is stable at room temperature and is nonhygroscopic. The ligands (L1–L7) were synthesized by the reaction between the carbonyl derivatives and

primary amine derivatives under microwave irradiation. The results of this study are summarized in Table (1). The Schiff base compounds were identified by FTIR spectra in the range (4000–400) cm^{-1} . All organic compounds have broad peak around (3280–3300) cm^{-1} , this due to O–H bond stretching [15], While the bands around (1602–1681) cm^{-1} , relate to C=N stretching (Schiff base bond) [16], the absorption bands at (1514–1600 cm^{-1}) corresponding to (C=C) of benzene ring [17,18]. UV/visible–spectra of Schiff base organic compounds exhibited three absorption bands between (207–258) nm suggesting to the (π – π^*) transition of (C=C) benzene ring, absorption bands between (280–315) nm suggesting to the (π – π^*) transitions of azomethine groups (C=N), and absorption bands at (426–461) nm suggesting the presence of (n – π^*) [19]. Table (2) shown the FTIR and UV–visible values of the prepared organic compounds.

Table(1)
Some physical properties and names of prepared organic compounds.

No.	Organic Compounds	Sym.	M.P.(C ^o)	Color	Time require (min)	Percentage %
1	N,N`-bis-[1-(2,4,6-trihydroxybenzene) ethylidene]-1,2-benzenediamine.	L1	115-117	Orange	2	60
2	N,N`-bis-[1-(2,4,6-trihydroxybenzene)ethylidene]-1,4-benzenediamine.	L2	136-138	Deep green	2	92
3	N,N`-bis-(2-hydroxy-1,2-diphenylethylidene)hydrazine.	L3	128-130	Clear yellow	25	71
4	N,N`,N``,N``-bis-(1,2-diphenylethylidene) hydrazine.	L4	98-100	Yellow shiny	2	82
5	Bis-(3-hydroxyimino 2-butylidene)1,2-phenylidenediimino	L5	115-117	Orange	2	60
6	Bis-(3-hydroxyimino-2-butylidene)1,4-phenylidenediimino	L6	136-138	Deep green	2	92
7	3-hydroxy-4-[(3-ydroxyimino) butane-2-ylidene) amino] naph thalene-1-sulfonic acid	L7	128-130	Clear yellow	25	71

Table (2)
FTIR and UV-visible values of prepared organic compounds in cm⁻¹ and nm respectively.

Symbol	O-H	C=N	C-N-	$\pi-\pi^*$	$\pi-\pi^*$	n- π^*
L1	3226	1631	823	237	280	428
L2	3302	1631	869	207	287	445
L3	3381	1680	856	248	-	461
L4	3064	1673	875	258	-	434
L5	3261	1618	831	236	302-315	432-450
L6	3220	1624	848	237	302	440
L7	3240	1602	893	248	309	448

Antibacterial Activity

The paper disc technique was used to evaluate the antibacterial activity of the synthesized organic compounds. The results of the bactericidal screening of the synthesized organic compounds are recorded. Thus inhibiting the growth of bacteria more potent than the parent Schiff base [20, 21]. The L2, L3 and L1 organic compounds have higher antimicrobial activity than the other organic compounds. The present (%) of inhibition was shown in Table (3) and also calculated by using the formula:

$$\% \text{ Inhibition} = [(T - C) \times 100] / T$$

Where C = the control plate; T = the test plate.

Table (3)
Antimicrobial activity of Schiff base organic compounds.

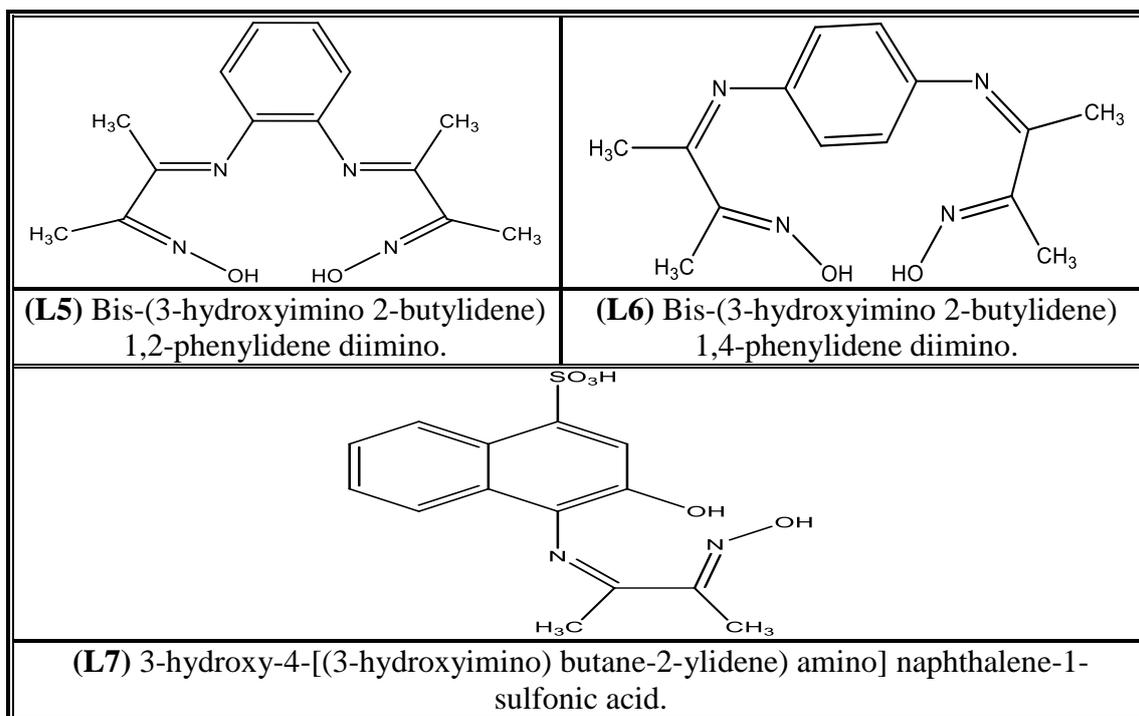
Compounds	<i>Pseudomonas aeruginosa</i> (gram negative)		<i>Staphylococcus aureus</i> (gram positive)	
	50 μ g	100 μ g	50 μ g	100 μ g
L1	14	50	<u>75</u>	<u>80</u>
L2	<u>84</u>	<u>77</u>	<u>70</u>	<u>80</u>
L3	73	80	43	79
L4	67	79	0	79
L5	43	79	0	43
L6	50	77	43	79
L7	40	50	25	40

The data reveal that the some of organic compounds have higher activities than other ligand.

Table (4) shows the suggested structures of prepared organic compounds and their nomenclatures. All these organic compounds may be act as the following suggested: L1 is monodentate, L2, L3, L4, L5, L7 are bidentate organic compounds, and L6 is tridentate organic compound.

Table (4)
The proposed structure of the Schiff Base and their nomenclatures.

(L1) N,N'-bis-[1-(2,4,6-trihydroxy benzene) ethylidene] -1,4-benzenediamine.	(L2) N,N'-bis-[1-(2,4,6-trihydroxy benzene) ethylidene] -1,2-benzenediamine.
(L3) N,N'-bis-(2-hydroxy-1,2-diphenylethylidene) hydrazine.	(L4) N,N',N'',N'''-bis-(1,2-diphenylethylidene)hydrazine.



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الخلاصة

تم تحضير المركبات العضوية (L7-L1) بواسطة جهاز المايكروويف وتم التأكد منها بالقياسات الفيزيائية والكيميائية حيث تم تشخيص الليكنيدات المحضرة بواسطة اطياف الاشعة تحت الحمراء والاشعة فوق البنفسجية والمرئية. قواعد شف المحضرة قد تكون ثنائية, ثلاثية او رباعية السن وتتناسق من خلال اوكسجين الهيدروكسيد او ذرة نتروجين الازوميثين. اختبرت الليكنيدات ضد الفعالية البكتيرية لبعض البكتيريا المرضية : *Staphylococcus aureus* (ايجابية الصفة) و *Pseudomonas aeruginosa* (سلبية الصفة), باستخدام طريقة اقراص الورق وزرعت الليكنيدات على سطح وسط غذائي. بينت النتائج ان الليكنيدات L2 و L3 لها اعلى فعالية بايولوجية بالتراكيز المنخفض والمرتفعة ضد البكتيريا نوع *Staphylococcus aureus* و *Pseudomonas aeruginosa* بالتتابع.

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