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Antimicrobial Study of Azo-imidazole (five cycles) Compounds

Samah Ahmed Kadhum[*1], Aseel Fadhil Kareem[2]

Abstract

Azo-imidazole compounds are class of important organic compounds that are containing (azo group with imine group, hetero cycles with hetero atoms) which considered to be the previously derivatives that have pharmacological and biological activities toward many types of pathogenic organisms due to their content of nitrogen and chlorine atoms in their structures. We prepared four types of azo- midazole derivatives (C15, C16, C17 and C18) at three different concentrations (5, 10 & 20 mg/ml^{-1}) to study their antimicrobial activity against two types of bacteria (*E. coli* and *P. vulgaris*) and two types of fungi (*A. niger* & *P. chrysogenum*) and we found the best derivatives antibacterial and antifungal activity were (C16 and C18) at concentration (20 mg/ml^{-1}) compared with other types through their ability to inhibit the growth of microbial isolates.

Key words: Azo-imidazole; Antibacterial activity; Antifungal activity.

* Correspondence author: az1978828@gmail.com
[1]*Head of Department of Clinical Laboratory Science, College of Pharmacy, University of Babylon
[2]Department of Pharmacology and Toxicology, College of Pharmacy, University of Babylon
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Introduction

Azo-imidazole compounds are very important in development of pharmaceutical and biological interest. These compounds are well known for their medicinal applications such as antiseptics, antifungal, antibacterial and antitumor activities [1, 8]. They are included in different biological activities like their ability to inhibit DNA, RNA and protein synthesis, prevent nitrogen fixation by some types of bacteria in addition to their carcinogenesis activity. Azo-imine compounds are present in the natural and pharmaceutical fields and probably their biological effects depended on their molecular structure [2, 3, 4]. Schiff bases play an important role in the amines aldehydes compounds because of their flexibility, structural similarities between them and natural biological substances in addition to the presence of imine (N=CH^{-}) that play a role in transformation and stimulation of different reactions in biological system [4]. Azo derivatives represent the largest class of dyes, their products are toxic and or mutagenic to life. They are studied for evaluation of their resistance against the growth of bacterial and fungal organisms, anthelmintic properties and dyeing

abilities on cotton fabrics biodegradation by various azo derivatives [9]. Five membered rings systems that are formally derived by fusion with other rings, either carbocyclic or heterocyclic, have a variety of common and systematic names.

For example, with the benzo-fused unsaturated nitrogen heterocycles, imidazole or benzo-imidazole pyrrole provides indole or isoindole dependi ng on the orientation [16]. A great importance in medicinal chemistry represented by using five membered heterocyclic, imidazole and determined their bioactivities through reactions have been focused on this ring system [5, 6]. From all the above we conclude that the occurrence of new diseases and bacterial and fungal resistance to currently drugs lead to necessary discovering of a new antimicrobial agents with novel mechanisms of action that inhibit the virulence factors of many organisms [7].

Objectives

The aim of this study is to determine the antimicrobial activity of four types of azo – imidazole compounds (C15, C16, C17 and C18) towards two types of bacteria (*E. coli* and *P. vulgaris*) and two types of fungi (*A. niger* & *P. chrysogenum*) at laboratory conditions.

Materials and Procedures

Chemical study:

We prepared many azo – imidazole compounds [C_{15} ($C_{23}H_{21}N_5O_6$), C_{16} ($C_{22}H_{18}N_5O_4Cl$), C_{17} ($C_{22}H_{18}N_5O_4Br$) and C_{18} $C_{22}H_{18}N_5O_4Cl$)] as in Scheme (1) by dissolving (0.02mol) from S_1 compound (3-((E) dihydroxyphenyl) diazenyl)-N-((Z)-4-hydroxy-3-methoxy benzylidene) benzohydrazide that prepared according to [8] in (25ml) of Tetrahydrofuran on the magnetic mixer then we added (0.02mol) of Glacial acetic acid then boiling this reaction to 50˚C for 17 hours. Drying the sedimentations then re-crystalized by absolute ethanol [9].

2- Biological activities:

The biological activities of prepared compounds have been tested for their antibacterial and antifungal activities by agar via biological methods. The antibacterial and antifungal studying were tested at three different concentrations (5, 10 & 20 mg/ml^{-1}) after dissolved these compounds in DMSO (Dimethyl sulfoxide) as solvent through using two types of bacteria (*E. Coli* & *P. Vulgaris*) and two types of fungi (*A. niger* & *P. chrysogenum*) and this work was specific for this research.

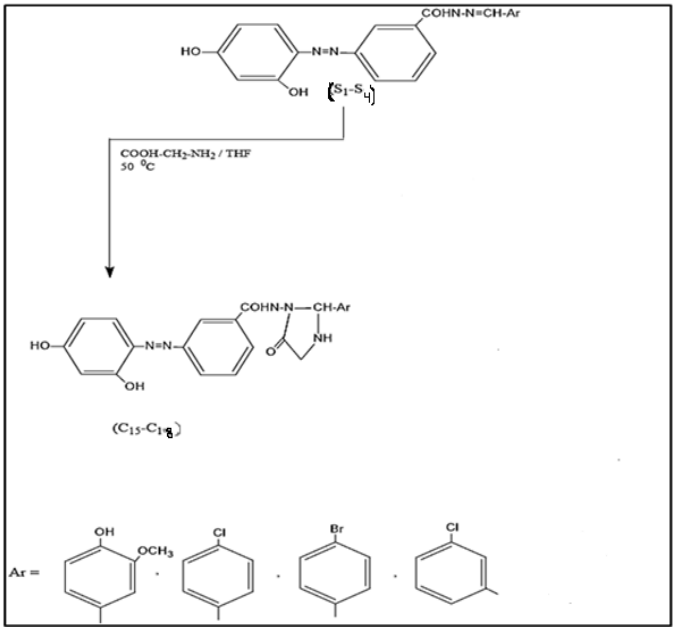
Microbiological study:

a-Isolation of bacteria:

Bacterial isolates (*E. coli* and *P. vulgaris*) were taken from patients suffering from UTIs were admitted to Al–Hilla Teaching laboratory Hospital in Babylon Province through a period from January till April 2017, recultured on specific culture media, then incubated at 37˚C for 24 hours for isolation. Bacterial isolates were identified according to [10, 11] by routine diagnostic tests including cultural, morphological and biochemical characteristics.

b- Isolation of fungi:

Fungi studied in this work (*A. niger* & *P. chrysogenum*) were isolated from rice and macaroni according to the method of [12]. The samples were directly placed on Potato dextrose agar (PDA) media supplemented with chloramphenicol to suppress bacterial growth and incubated at 25˚C for 2 days. Then we identified these fungi by the basis of their micro and macro-morphological characteristics using standard taxonomic key as in [12, 13].



Scheme 1

Preparation of Azo- Imidazole compounds (C_{15} , C_{16} , C_{17} and C_{18}).

Results and Discussion

In previously paper of our work, we synthesized these azo-imidazole compounds (C15, C16, C17 and C18) to study the antibacterial and antifungal activities. The antimicrobial activity of these compounds were screened as in table (1), From these results we found the potential activity of these compounds at three concentrations (5, 10 & 20 mg/ml^{-1}) against two strain of bacteria *E. coli* & *P. vulgaris* that used in this study, As similar as the antifungal activity against two species of fungi *A. niger* & *P. crysogenum* were summarized in table (2). It is evident from the results that the biological activity of all compounds was increased and caused the inhibition the growth of bacteria and fungi and these results were agreements with [13]. The azo compounds caused damage of bacterial or fungal cell wall and alter the permeability of it or may cause changes in the metabolic pathway of them in addition to denaturant the proteins of cells and inhibition in their activities [1]. The high bi -activity of compounds [C16 and C18] may be due to their

structures which are containing imidazoline ring and chlorine in compounds that inhibit cellular protein and RNA of bacteria, also they included some groups with nitrogen atoms and hence inhibit the bacterial and fungal growth as in pictures (1, 2, 3, 4) by formation of hydrogen bond with active centers in the cell contents that participated with the normal cell functions [7, 3]. The antimicrobial activity of these compounds depended on physical and chemical properties of molecules through changing the permeability of cellular membrane that lead to the death of cells [14].

Table 1

Inhibition zone diameters (mm) of four azo – imidazole compounds at different concentrations (5, 10 &20 mg/ml^{-1}) against bacterial growth

Compounds numbers	**Concentrations (mg/ml^{-1})**	**Mean of inhibition zone(mm)**	
		P. vulgaris	***E. coli***
C15	5	22	14
	10	22	16
	20	26	20
C16	5	28	20
	10	28	22
	20	32	26
C17	5	18	14
	10	18	14
	20	22	18
C18	5	28	16
	10	30	20
	20	34	22

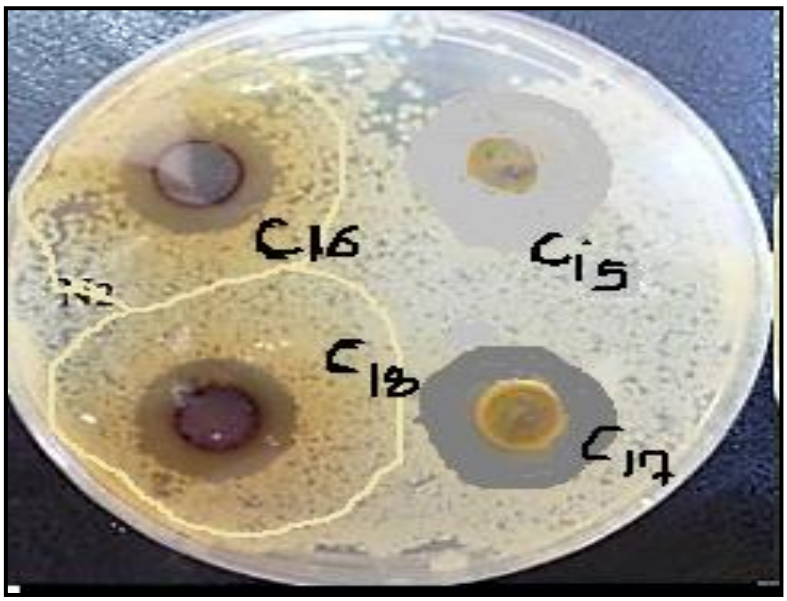


Figure 1
Antibacterial activity of *azo – imidazole compounds on P. vulgaris* at concentration (20mg/ ml^{-1})

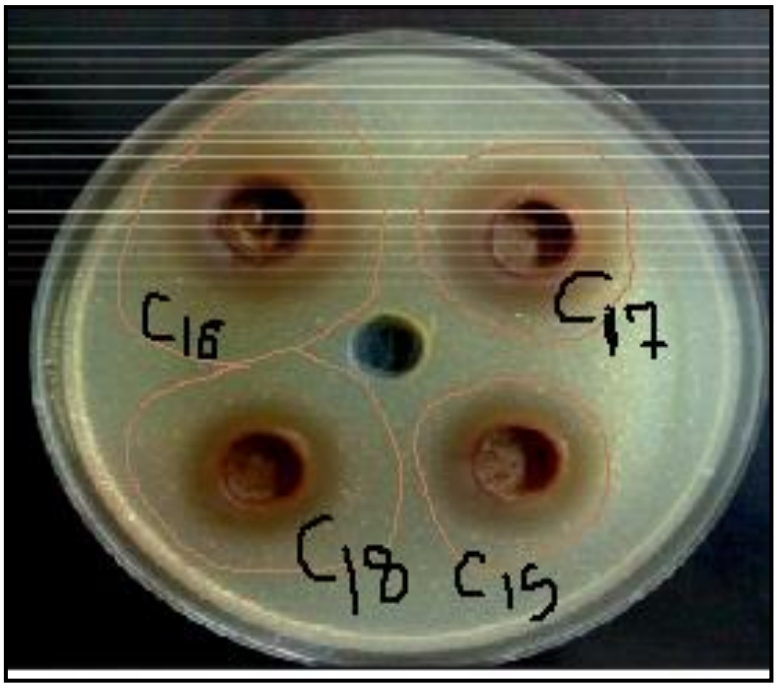


Figure 2
Antibacterial activity of azo – imidazole compounds on *E. coli at* concentration (20mg/ ml^{-1}).

Cyclic compounds containing N-donor of five membered ring have attracted a lot of interest due to their potent pharmaceutical properties that have been widely studied like antifungal, antibacterial, anticancer with HIV- inhibitors, herbicidal applications and other applications in medicine and

chemistry fields. It is also because of their potential of chemical permutation.

The biological activity of the azo - imidazole cycles depends to a large extent on the nature of hetero atoms in their structures [14, 15].

Table 2

Inhibition zone diameters (mm) of four azo – imidazole compounds at different concentrations (5, 10 &20mg/ml^{-1}) against fungal growth.

Compounds numbers	**Concentrations (mg/ml^{-1})**	**Mean of inhibition zone(mm)**	
		A. niger	***P. crysogenum***
C15	5	12	14
	10	16	14
	20	20	16
C16	5	20	18
	10	22	18
	20	26	22
C17	5	14	8
	10	14	8
	20	16	12
C18	5	16	16
	10	20	16
	20	22	18

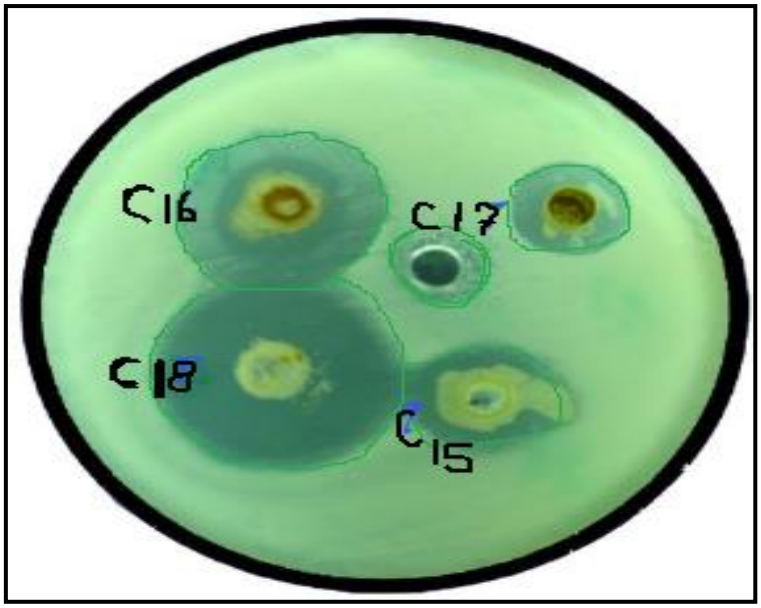


Figure 3
Antifungal activity of azo-imidazole compounds on *A. niger* at concentration (20mg/ml^{-1}).

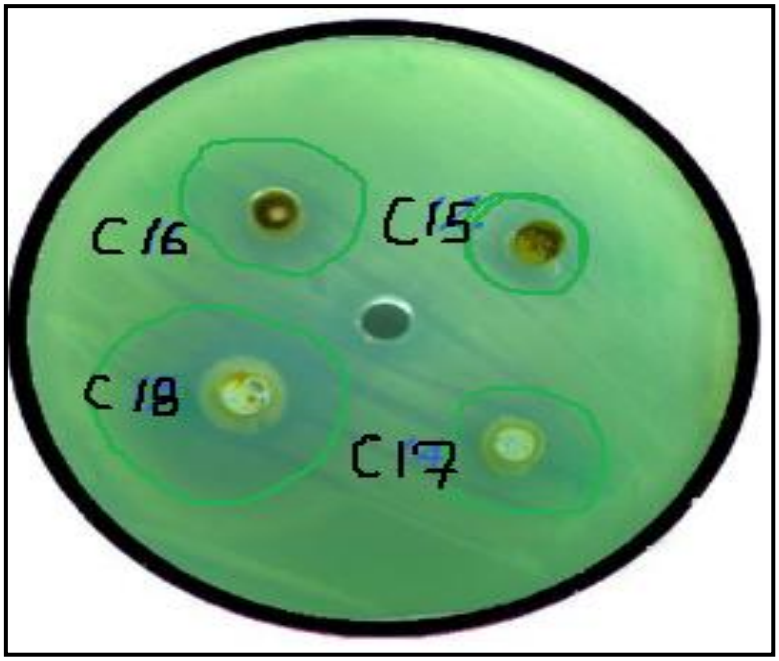


Figure 4
Antifungal activity of azo-imidazole compounds on *P. crysogenum* at concentration (20mg/ml^{-1}).

Conclusions

Azo- compounds (C15, C16, C17 and C18) were previously prepared and considered to be the novel chemical derivatives. The biological activity against different infections agents would be benefits for us through their ability to inhibit the growth of organisms with different inhibition zones. The antimicrobial activity of these

compounds depended on the presence of aromatic ring structure that are more active and safely in use.

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