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A Study of Antibacterial and Antifungal Activities of Visible Light-Mediated, Eosin Y-Catalyzed, Synthesized Derivatives of Isoxazoles

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Abstract: ***In this antimicrobial examination by single spore isolation, disc diffusion method, all synthesized (4a-4p) Isoxazoles scaffolds shows Antibacterial activity and antifungal activity. The compounds (4a, 4g, 4h, 4i, 4l, 4n, 4O) shows best antibacterial activity against Gram positive bacteria Staphylococcus aureus, Bacillus subtilis, Gram negative bacteria Pseudomonas aeruginosa, Escherichia coli and antifungal activity against Aspergillus niger.***

Keywords: Antibacterial activity, Inhibition zones, Single spore isolation, Disk diffusion

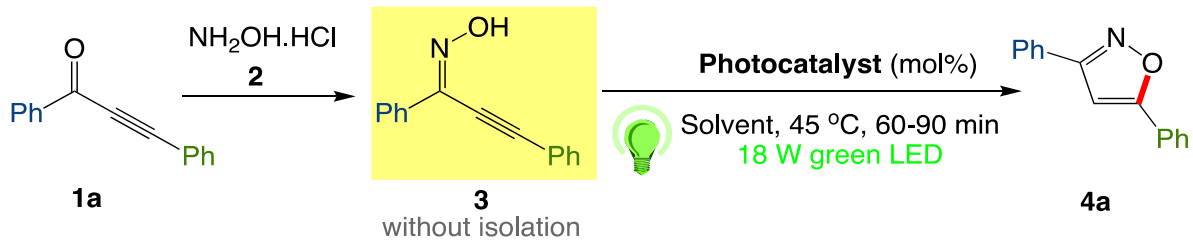
1. Introduction

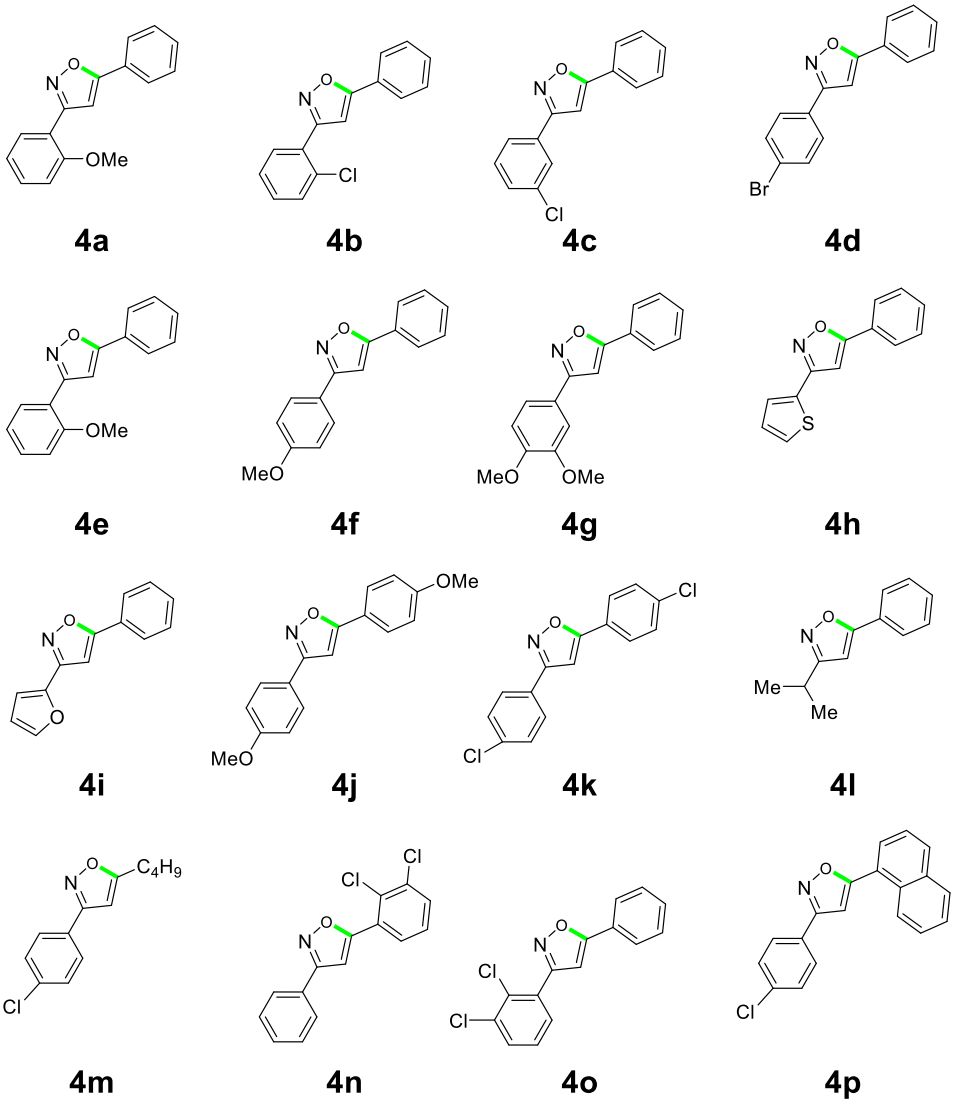
Five-membered heterocyclic compounds having one nitrogen and one oxygen atom connected adjacent to each other called Isoxazoles. A highly significant medicinally valuable scaffold due to its potent therapeutic activity. Biological evaluation by molecular docking shows that isoxazoline derivatives have potent antibacterial [1, 2] activity, however anticancer [3, 4], antioxidant [5, 6] Antifungal [7, 8], insecticidal [9], Antidiabetic [10, 11], anti-inflammatory [12, 13], and analgesic [14], activities of these scaffolds are also well known. It is active against the Alzheimer's [15, 16] which is a progressive loss of memory. The naturally occurring, heterocyclic derivatives provide more attention for their applications.

Antibacterial evaluation of synthesized compounds (4a-4p) has been carried out by disc diffusion method [17] against of S. aureus, B. subtilis and P. aeruginosa, E. coli and antifungal evaluation against A. niger. Staphylococcus aureus causes infections in human and other animals [18, 19]. Bacillus subtilis is a naturally transformable, gram positive, fast growing, aerobic, rod-shaped bacteria, and it is easy for culture. The endo-spores produced by Bacillus subtilis provide fruitful system for studying their biofilms [20]. Pseudomonas aeruginosa, is an important pathogen, infect hospitalized peoples and other cystic fibrosis patients [21]. Escherichia coli is rod shaped, 2.0 µm long, coli form bacterium [22, 23], and found in lower intestine of warm-blooded organism [24, 25]. Aspergillus niger 'black mould' causes infections on onions, grapes and other many fruits, having 3-5 µm of spherical conidia, Isolated from seeds of Soybean, Maize, Gram seeds.

2. Experimental

Table 1. Scheme of reaction and synthesized products (Our previous work):





Compounds (4a-4p) were evaluated in vitro using the Nutrient Agar (NA) and Dextrose Agar (DA) by disc diffusion method, N, N-DMF is used as solvent. Nutrient Agar medium (NA) was used for bacterial sub-culture, and Dextrose Agar (DA) is used for fungal sub-culture. Petri plates were prepared by pouring 50 mL of NA or DA and allowing it to solidify. The bacterial and fungal species were isolated by single spore isolation method from infected part of hosts.

Inoculum was prepared from the above cultures, by taking 4 to 5 colonies, and transferred in 10 mL 0.7% saline with the help of wire loop. Inoculum was incubated at 30^0 C for 3 hours. Some of them exceeds turbidity of 0.5 Mac Farland standards, their turbidity was reduced by adding same saline. Plates were dried and 5 mL of each standardized inoculums suspension was poured and uniformly spread.

Antibacterial agents Ciprofloxacin, Amoxicillin and antifungal agent Amphotericine-B, were used as standard drugs, DCM alone shows no inhibition zone. The plates were incubated at 37 °C for 24 h. The results were recorded for each tested compound as the average diameter of inhibition zones of microbial growth around the disks in mm. The bactericidal and fungicidal activity of synthesized all sixteen (4a to 4p) compounds has been screened and data is given in Table-2.

Figure1: Antibacterial efficiency of **(4h, 4i)** against Staphylococcus aureus with reference drug **Amoxicillin.**

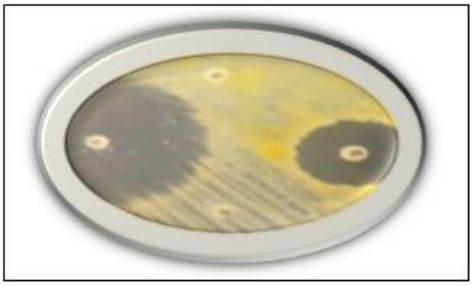


Figure 2: Antifungal efficiency of **(4h)** against Aspergillus Niger **with reference drug Amphotericine-B**

*Inhibition zone in mm for Isoxazoles and reference drugs

Table 2: Data of bactericidal/fungicidal evaluation for Isoxazoles scaffolds

S.N.	Spiro-Pyrazolones	Gram (+) Ve, Bacteria*		Gram (-) Ve, Bacteria*		Fungi*
		S. aureus	B. subtilis	P. aeruginosa	E. coli	A. nigar
1	4a	22	10	13	12	07
2	4b	12	12	10	08	09
3	4c	11	06	02	12	09
4	4d	12	10	11	15	08
5	4e	15	08	11	12	10
6	4f	10	10	12	11	10
7	4g	23	23	26	20	10
8	4h	24	25	16	12	14
9	4i	23	10	13	10	10
10	4j	11	11	13	09	11
11	4k	11	14	11	11	04
12	4l	10	12	28	21	05
13	4m	13	17	17	13	09
14	4n	15	11	20	22	11
15	4o	17	14	25	20	13
16	4p	12	10	12	14	09
X	Amphotericine-B	-	-	-	-	26.8
Y	Ciprofloxacin	-	-	30.2	25.8	
Z	Amoxicillin	25.6	28.3	-	-	-

3. Result and Discussions

Antibacterial activity and antifungal activity evaluation of Isoxazoles scaffolds of synthesized, our all sixteen derivatives of isoxazoles shows that all are antimicrobial with moderate to low range.

Antibacterial activity evaluation of (4a-4p) Isoxazoles scaffolds shows that the molecule 4g shows best antibacterial activity against both the Gram (+) Ve, Bacteria and Gram (-) Ve, Bacteria having inhibition zone nearest to their reference drugs, due to presence of -OCH_3 anti position to ring's nitrogen and oxygen interactions but 4h is highly active against only B. subtilis and S. aureus having inhibition zone 25, 24 mm near to that of Amoxicillin. It is due to presence of lone pair electron interactions of sulphur of thiophene. The compound 4I is active against S. aureus with inhibition zone 23 mm and active against B. subtilis with low inhibition zone 10 mm having oxygen atom of furan group. The compound 4g and 4l are active against both gram negative bacterium, P. aeruginosa and E. coli with inhibition zones 28 and 21 mm having closer to reference drug ciprofloxacin of 30.2 and 25.8 mm. The compound 4a is also highly active against S. aureus with inhibition zone 22 mm close to reference drugs amoxicillin having inhibition zone 25.6 mm.

Antifungal activity evaluation of (4a-4p) Isoxazoles scaffolds shows that the compounds having antifungal activity with low to moderate range. However, the Isoxazoles 4h, 4n, 4o, are highly active against A. niger with inhibition zone 14, 11, 13, near to their reference drug Amphotericine-B having that of 26.8 mm, it is due to presence of Sulphur and chlorines at anti position of nitrogen and oxygen atoms of isoxazole ring.

4. Conclusions

Here we have evaluated our synthesized all (4a-4p) Isoxazoles scaffolds for their Antibacterial activity and antifungal activity against Gram-positive bacteria and Gram-negative bacteria and fungus by disc diffusion method. All are active against the selected microbs.

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