CHAPTER: 5 BIOLOGICAL EVALUATION

5.1 BIOLOGICAL EVALUATION OF NEWLY SYNTHESIZED COMPOUNDS: Introduction

Antimicrobial drugs are among the most widely used and misused of all drugs. The expected consequence of extensive use of the antimicrobial agents has been coming out of antibiotics resistance pathogens leading to researching new drugs, some novel drug agent being introduced into clinical practice each year. Although awareness of the consequences of antibiotic misuse increasing.

Drugs used for the cure of disease is never ending the struggle and it started with the existence of mankind. Pharmacology is the scientific approach for this struggle. Drug word obtained from word "drogue" in French and its calls a dry herb. The synthesis of a number of Oxazolone, Imidazolone and s-Triazine compounds of potential antimicrobial interest have been carried out. Only representative numbers of these compounds have been screened for their antimicrobial activity. Antonie Van Leeuwenhoek identified bacteria following his microscope invention in the 1670s. It was an unknown link between disease and bacteria until French scientist Pasteur demonstrated that specific bacteria strains were important to fermentation. Hans Christian Gram developed a differential staining technique to identify and classification bacteria in Microbiology and is called Gram staining in 1884s. The bacteria divided into two groups. A German scientist C.E. Chrenberg first use of “Bacteria” refers to the micro-organism, as a relatively simple and original organization called prokaryotic.

Gram-positive bacteria contain a cell wall composed of a single layer of peptidoglycan. Gram-negative bacteria contain a cell wall with several thin layers of composed peptidoglycan, lipopolysaccharide and protein. The cell wall of Gram-positive bacteria is generally thicker than Gram-negative bacteria. The Gram stain identification requires dyes and expensive microscope. Robert Koch known as ‘Father of Medical Microbiology’
developed staining technique and standardized the method of growing bacteria on solid media. Bacteria have a single circular DNA chromosome that is found within the cytoplasm of the cell as they do not have a nucleus.

**Difference between Gram-positive bacteria and Gram-negative bacteria**

Peptidoglycan structure as a unit of NAG and NAM joined by the side chain of four amino acid vertically and amino acid cross-bridge. The cell wall of Gram-positive bacteria cell wall made out of peptidoglycan combined with teichoic acid molecules keeps their purple color when purple dye spread over bacteria.
The cell wall of Gram-negative bacteria cell wall made out of thinner phospholipid without teichoic acid molecules which lose their purple color stain when purple dye spread over bacteria and become colorless and a second red stain used to see these bacteria under microscope. The gram-negative bacteria cell wall is destroyed when placed in 3% potassium hydroxide an alkaline solution and the DNA and cell content released. The potassium hydroxide 3% solution will not impact on gram-positive bacteria and the KOH method was developed by a Japanese scientist Ryu in 1938.

The parasite bacteria pathogenic to human beings are as follow.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td><em>Bacillus anthracia</em></td>
</tr>
<tr>
<td>Cholera</td>
<td><em>Vibrio cholerae</em></td>
</tr>
<tr>
<td>Diarrhoea</td>
<td><em>Bacillus coli</em></td>
</tr>
<tr>
<td>Diptheria</td>
<td><em>Corynebacterium diphtheriae</em></td>
</tr>
<tr>
<td>Dysentry</td>
<td><em>Schizella dysenteriae</em></td>
</tr>
<tr>
<td>Gastroenteritis</td>
<td><em>Escherichia coli</em></td>
</tr>
<tr>
<td>Jaundice</td>
<td><em>Leptopia ictero-haemorrhagiae</em></td>
</tr>
<tr>
<td>Leprosy</td>
<td><em>Mycobacterium leprae</em></td>
</tr>
<tr>
<td>Meningitis</td>
<td><em>Neisseria meningitides</em></td>
</tr>
<tr>
<td>Plague</td>
<td><em>Pasteurella pestis</em></td>
</tr>
<tr>
<td>Pneumonia</td>
<td><em>Streptococcus pneumoniae</em></td>
</tr>
<tr>
<td>Tetanus</td>
<td><em>Clostridium tetani</em></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td><em>Microbacterium tuberculosis</em></td>
</tr>
<tr>
<td>Typhoid</td>
<td><em>Salmonella typhi</em></td>
</tr>
</tbody>
</table>

The parasitic bacteria decompose food crops and lead to financial loss.

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Bacteria</th>
<th>plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilt</td>
<td><em>Pseudomonas solanacearum</em></td>
<td>Brinjal, potato</td>
</tr>
<tr>
<td>Rots</td>
<td><em>Erwinia aroideae</em></td>
<td>potato, reddish</td>
</tr>
<tr>
<td>Blights</td>
<td><em>Erwinia amylovera</em></td>
<td>apple, pears</td>
</tr>
<tr>
<td>Citrus canker</td>
<td><em>Xanthomonas citri</em></td>
<td>plant leaf and on fruit</td>
</tr>
</tbody>
</table>
Synthesis and Characterization of s-Triazine and Imidazole Heterocycles

5.2 ANTIBACTERIAL AND ANTIFUNGAL ACTIVITY

Antibacterial and antifungal activity of synthesized compounds has been performed. The bacterial strains like an Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Streptococcus pyogenes were used for evaluate antibacterial activity. Antifungal activity was evaluated against different fungal strain like a Candida albicans, Aspergillus niger, and Aspergillus clavatus by measuring the zone of inhibition in mm. Compounds structure was proved by NMR, IR, and Mass spectra analysis. A work towards produce facile, effective and eco-friendly methodology and several bioactive compounds.

Four major methods generally used for evaluation of antimicrobial activity such as
Broth dilution, Paper Disc, Agar Cup and Agar Ditch method.

Broth dilution evaluation method was used to measure minimum inhibitory concentration (MICs) and is widely used as non-automated in vitro microbial susceptibility test. An antimicrobial minimum concentration which inhibits the growth of the organism on antibiotics free media term called Minimum bactericidal concentrations (MBCs) 225-226.

The synthesized compounds were tested for bioactivity in reference to standard antibacterial drugs Gentamycin, Ampicillin, Chloramphenicol, Ciprofloxacin, Norfloxacin, and antifungal drugs Nystatin and Griseofulvin.

MICRO BROTH DILUTION METHOD:

Determination of minimal inhibition concentrations as established method 227-230.

Minimum inhibitory concentrations (MICs) as per broth method 231.

PRIMARY & SECONDARY-SCREENING:

Each synthesized drug was diluted obtaining 2000 μg/mL concentration, as a stock, solution then followed by 1000, 500, 200, 100 μg/mL respectively dilution.
The synthesized compounds performed primary screening than secondary screening for active compounds and read the result as per the inhibition zone.

5.3 PROTOCOL FOR ANTIBACTERIAL ACTIVITY:

The synthesized compounds were screened for their in-vitro antimicrobial activity against *Escherichia coli* (Gram-negative) 433, *Pseudomonas aeruginosa* (Gram-negative) 1688, *Staphylococcus aureus* (Gram-positive) 96, *Streptococcus pyogenes* (Gram-positive) 442. The result of this test is affected by the size of the inoculums. Gentamycin, Ampicillin, Chloramphenicol, Ciprofloxacin, Norfloxacin drugs are used for antibiotic references. Summary of the antibacterial activity in table 9.4. The strains source: Institute of Microbial Technology, Chandigarh.

**Protocol for antifungal activity:**

Nystatin and Griseofulvin drugs are used for antifungal reference. Summary of the antifungal activity in table 10.4. Antifungal activity was performed of synthesized drugs for synthesized drugs against below strains: Candida Albicans (227), Aspergillus Niger (282), Aspergillus Clavatus (1323)

**The Standard Drugs:**

The standard drug Gentamycin exhibited antibacterial activity 0.05μg/ml for *Escherichia coli*- 433, 1μg/ml for *Pseudomonas aeruginosa*-1688, 0.25μg/ml for *Staphylococcus aureus*-96, 0.5 μg/ml for *Streptococcus pyogenes*-442. The standard drug Ampicillin exhibited antibacterial activity 100 μg/ml for *Escherichia coli*- 433, none for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 100 μg/ml for *Streptococcus pyogenes*-442. The standard drug Chloramphenicol exhibited antibacterial activity 50 μg/ml for *Escherichia coli*- 433, 50μg/ml for *Pseudomonas aeruginosa*-1688, 50 μg/ml for *Staphylococcus aureus*-96, 50 μg/ml for *Streptococcus pyogenes*-442. The standard drug Norfloxacin exhibited antibacterial activity 10 μg/ml for *Escherichia coli*- 433, 10μg/ml for *Pseudomonas aeruginosa*-1688, 10 μg/ml for *Staphylococcus aureus*-96, 10 μg/ml for *Streptococcus pyogenes*-442.
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The strains image:

*Escherechia coli* (Gram negative)  *Pseudomonas aeruginosa* (Gram negative)

*Staphylococcus aureus* (Gram positive)  *Streptococcus pyogenes* (Gram positive)

*Candida albicans*  *Aspergillus niger*:

*Aspergillus clavatus*
Antibacterial and antifungal drugs use as reference standards.

I: Gentamicin

II: Ampicillin

III: Chloramphenicol

IV: Ciprofloxacin

V: Norfloxacin

VI: Griseofulvin

VII: Nystatin
5.4 RESULT, DISCUSSION, AND CONCLUSION:
The synthesized drugs were compared with standard antibacterial drugs Gentamycin which showed 0.05, 1, 0.25, 0.5 μg/mL Minimal bactericidal concentration (MBC) against strains.

The experimental data from tables shown that some compound inhibits the growth of the Gram-positive, Gram-negative bacteria species and fungus among tested all compounds.

**Oxazolone compounds biological activity:**
- Moderate Antibacterial activity: 4c, 4d, 4h, 4i, 7d, 7f, 7g
- Good Antibacterial activity: 4j, 7a, 7c, 7j
- Moderate Antifungal activity 4g, 4f, 4h, 7e, 7g
- Good Antifungal activity 4d, 4g, 4j, 7b, 7i

**Imidazolone compounds biological activity:**
- Moderate Antibacterial activity: 5e, 5g, 5h, 6b, 8a, 8c, 8h, 8j, 9b, 9e, 9f, 9g, 9h, 9j
- Good Antibacterial activity: and 5f, 6f, 6g, 8g, 9e
- Moderate Antifungal activity: 5c, 5d, 5i, 5j, 6d, 6i, 8d, 8g, 9c, 9e
- Good Antifungal activity: 5b, 5g, 6c, 6h, 8i, 9j

**s-Triazine compounds biological activity:**
- Moderate Antibacterial activity: Br₁, Br₂, Br₃, Br₄, Br₅, Br₆, Br₇, Br₈, Br₉, Br₁₁, Cl₄, Cl₇, Cl₈, Cl₁₀, Cl₁₁
- Good Antibacterial activity: Br₁₂, Cl₂, Cl₃
- Moderate Antifungal activity: Br₃, Br₄, Br₆, Cl₃, Cl₉
- Good Antifungal activity: Br₁₂, Cl₄, Cl₆, Cl₁₁

Hence these compounds should be further tested under different conditions for their pharmaceutical applications.
5.4.1: Antibacterial activity data of 4-(substitutedbenzylidene)-2-(substitutedphenyl)-1,3-oxazol-5(4H)-ones. (4a-j, 7a-j).

**Data Table: 10.1.4**

**Minimal bactericidal concentration (MBC) in μg / ml**

The product 4a where -R₁ = -H, exhibited antibacterial activity 250 μg/ml for *Escherichia coli* - 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 4b where -R₁ = 2-NO₂, exhibited antibacterial activity 500 μg/ml for *Escherichia coli* - 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 200 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 4c where -R₁ = 2-Cl, exhibited antibacterial activity 200 μg/ml for *Escherichia coli* - 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 100 μg/ml for *Staphylococcus aureus*-96, 200 μg/ml for *Streptococcus pyogenes*-442.

The product 4d where -R₁ = 4-Cl, exhibited antibacterial activity 100 μg/ml for *Escherichia coli* - 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 4e where -R₁ = 4-methoxy, exhibited antibacterial activity 250 μg/ml for *Escherichia coli* - 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442. The product 4f where -R₁ = 3, 4-(OCH₃)₂, exhibited antibacterial activity 500 μg/ml for *Escherichia coli* - 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 100 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442. The product 4g where -R₁ = 2-methoxy, exhibited antibacterial activity 250 μg/ml for *Escherichia coli* - 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 4h where -R₁ = 4- Me, exhibited antibacterial activity 500 μg/ml for *Escherichia coli* - 433, 100 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 100 μg/ml for *Streptococcus pyogenes*-442. The product 4i where -R₁ = 3-Br, exhibited...
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antibacterial activity 100 μg/ml for *Escherchial coli- 433*, 500 μg/ml for *Pseudomonas aeruginosa-1688*, 250 μg/ml for *Staphylococcus aureus-96*, 500 μg/ml for *Streptococcus pyogenes-442*.

The product 4j where \(-R_1= 3,4,5\-(OCH_3)_3\), exhibited antibacterial activity 62.5 μg/ml for *Escherchial coli- 433*, 200 μg/ml for *Pseudomonas aeruginosa-1688*, 500 μg/ml for *Staphylococcus aureus-96*, 500 μg/ml for *Streptococcus pyogenes-442*.

The product 7a where \(-R_1= -H\), exhibited antibacterial activity 125 μg/ml for *Escherchial coli- 433*, 200 μg/ml for *Pseudomonas aeruginosa-1688*, 62.5 μg/ml for *Staphylococcus aureus-96*, 100 μg/ml for *Streptococcus pyogenes-442*. The product 7b where \(-R_1= 2-\text{NO}_2\), exhibited antibacterial activity 125 μg/ml for *Escherchial coli- 433*, 500 μg/ml for *Pseudomonas aeruginosa-1688*, 500 μg/ml for *Staphylococcus aureus-96*, 200 μg/ml for *Streptococcus pyogenes-442*. The product 7c where \(-R_1= 2-\text{Cl}\), exhibited antibacterial activity 250 μg/ml for *Escherchial coli- 433*, 250 μg/ml for *Pseudomonas aeruginosa-1688*, 62.5 μg/ml for *Staphylococcus aureus-96*, 200 μg/ml for *Streptococcus pyogenes-442*.

The product 7d where \(-R_1= 4-\text{Cl}\), exhibited antibacterial activity 100 μg/ml for *Escherchial coli- 433*, 100 μg/ml for *Pseudomonas aeruginosa-1688*, 500 μg/ml for *Staphylococcus aureus-96*, 250 μg/ml for *Streptococcus pyogenes-442*. The product 7f where \(-R_1= 3, 4-(OCH_3)_2\), exhibited antibacterial activity 200 μg/ml for *Escherchial coli- 433*, 100 μg/ml for *Pseudomonas aeruginosa-1688*, 100 μg/ml for *Staphylococcus aureus-96*, 100 μg/ml for *Streptococcus pyogenes-442*. The product 7g where \(-R_1= 2-\text{methoxy}\), exhibited antibacterial activity 250 μg/ml for *Escherchial coli- 433*,
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100 μg/ml for *Pseudomonas aeruginosa* -1688, 100 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442. The product 7h where -R1= 4- Me, exhibited antibacterial activity 200 μg/ml for *Escherichia coli*-433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 100 μg/ml for *Streptococcus pyogenes*-442.

The product 7i where -R1= 3-Br, exhibited antibacterial activity 250 μg/ml for *Escherichia coli*- 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 7j where -R1= -3,4,5-(OCH3)3, exhibited antibacterial activity 100 μg/ml for *Escherichia coli*- 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 62.5 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442.

**5.4.2: Antibacterial activity data of 4-(substitutedbenzyldene)-2-(3-Mephenyl)-1-(substitutedphenyl)-4H-imidazol-5-ones. (5a-j, 6a-j).**

The product 5a where -R1= -H, exhibited antibacterial activity 500 μg/ml for *Escherichia coli*- 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 5b where -R1= 2-NO2, exhibited antibacterial activity 200 μg/ml for *Escherichia coli*- 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442.

The product 5c where -R1= 2-Cl, exhibited antibacterial activity 500 μg/ml for *Escherichia coli*- 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 200 μg/ml for *Streptococcus pyogenes*-442. The product 5d where -R1= 4-Cl, exhibited antibacterial activity 200 μg/ml for *Escherichia coli*- 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442.
The product 5e where \(-R_1=4\text{-methoxy}\), exhibited antibacterial activity 100 μg/ml for *Escherichia coli* -433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442.

The product 5f where \(-R_1=3, 4\text{-}(OCH}_3)_2\), exhibited antibacterial activity 200 μg/ml for *Escherichia coli*- 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 62.5 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442. The product 5g where \(-R_1=2\text{-methoxy}\), exhibited antibacterial activity 100 μg/ml for *Escherichia coli*- 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 5h where \(-R_1=4\text{-Me}\), exhibited antibacterial activity 250 μg/ml for *Escherichia coli*- 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 100 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 5i where \(-R_1=3\text{-Br}\), exhibited antibacterial activity 250 μg/ml for *Escherichia coli*- 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 200 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 5j where \(-R_1=-3,4,5\text{-}(OCH}_3)_3\), exhibited antibacterial activity 200 μg/ml for *Escherichia coli*- 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 6a where \(-R_1=-H\), exhibited antibacterial activity 200 μg/ml for *Escherichia coli*- 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 6b where \(-R_1=2\text{-NO}_2\), exhibited antibacterial activity 200 μg/ml for *Escherichia coli*- 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 100 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.
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The product 6c where \(-R_1= 2\text{-Cl}\), exhibited antibacterial activity 500 μg/ml for *Escherechia coli* 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442. The product 6d where \(-R_1= 4\text{-Cl}\), exhibited antibacterial activity 250 μg/ml for *Escherechia coli* 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 6e where \(-R_1= 4\text{-methoxy}\), exhibited antibacterial activity 200 μg/ml for *Escherechia coli* 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442.

The product 6f where \(-R_1= 3, 4\text{-}(OCH}_3\)\(_2\)\), exhibited antibacterial activity 100 μg/ml for *Escherechia coli* 433, 62.5 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442. The product 6g where \(-R_1= 2\text{-methoxy}\), exhibited antibacterial activity 250 μg/ml for *Escherechia coli* 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 62.5 μg/ml for *Streptococcus pyogenes*-442.

The product 6h where \(-R_1= 4\text{-Me}\), exhibited antibacterial activity 250 μg/ml for *Escherechia coli* 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 100 μg/ml for *Staphylococcus aureus*-96, 100 μg/ml for *Streptococcus pyogenes*-442.

The product 6i where \(-R_1= 3\text{-Br}\), exhibited antibacterial activity 250 μg/ml for *Escherechia coli* 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 500 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 6j where \(-R_1= -3,4,5\text{-}(OCH}_3\)\(_3\)\), exhibited antibacterial activity 200 μg/ml for *Escherechia coli* 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442.
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5.4.3: Antibacterial activity data of 4-(substitutedbenzylidene)-2-(4-chlorophenyl)-1-(substitutedphenyl)-4H-imidazol-5-ones. (8a-j, 9a-j).

The product 8a where \(-R_1=-H,\) exhibited antibacterial activity 500 μg/ml for *Escherichia coli* - 433, 100 μg/ml for *Pseudomonas aeruginosa*-1688, 250 μg/ml for *Staphylococcus aureus*-96, 500 μg/ml for *Streptococcus pyogenes*-442. The product 8b where \(-R_1=2-\text{NO}_2,\) exhibited antibacterial activity 200 μg/ml for *Escherichia coli* - 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 200 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 8c where \(-R_1=2-\text{Cl},\) exhibited antibacterial activity 100 μg/ml for *Escherichia coli* - 433, 200 μg/ml for *Pseudomonas aeruginosa*-1688, 100 μg/ml for *Staphylococcus aureus*-96, 200 μg/ml for *Streptococcus pyogenes*-442. The product 8d where \(-R_1=4-\text{Cl},\) exhibited antibacterial activity 250 μg/ml for *Escherichia coli* - 433, 250 μg/ml for *Pseudomonas aeruginosa*-1688, 200 μg/ml for *Staphylococcus aureus*-96, 250 μg/ml for *Streptococcus pyogenes*-442.

The product 8e where \(-R_1=4-\text{methoxy},\) exhibited antibacterial activity 200 μg/ml for *Escherichia coli* - 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 200 μg/ml for *Staphylococcus aureus*-96, 200 μg/ml for *Streptococcus pyogenes*-442. The product 8f where \(-R_1=3, 4-(\text{OCH}_3)_2,\) exhibited antibacterial activity 250 μg/ml for *Escherichia coli* - 433, 500 μg/ml for *Pseudomonas aeruginosa*-1688, 200 μg/ml for *Staphylococcus aureus*-96, 200 μg/ml for *Streptococcus pyogenes*-442.

The product 8g where \(-R_1=2-\text{methoxy},\) exhibited antibacterial activity 250 μg/ml for *Escherichia coli* - 433, 100 μg/ml for *Pseudomonas aeruginosa*-1688, 62.5 μg/ml for *Staphylococcus aureus*-96, 100 μg/ml for *Streptococcus pyogenes*-442.
The product 8h where -R$_1$= 4- Me, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 500 µg/ml for *Pseudomonas aeruginosa*-1688, 100 µg/ml for 
*Staphylococcus aureus*-96, 100 µg/ml for *Streptococcus pyogenes*-442. The product 8i where -R$_1$= 3-Br, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 250 µg/ml for *Pseudomonas aeruginosa*-1688, 500 µg/ml for 
*Staphylococcus aureus*-96, 500 µg/ml for *Streptococcus pyogenes*-442. The product 8j where -R$_1$= -3,4,5-(OCH$_3$)$_3$, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 100 µg/ml for *Pseudomonas aeruginosa*-1688, 250 µg/ml for *Staphylococcus aureus*-96, 250 µg/ml for *Streptococcus pyogenes*-442.

The product 9a where -R$_1$= -H, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 500 µg/ml for *Pseudomonas aeruginosa*-1688, 500 µg/ml for 
*Staphylococcus aureus*-96, 500 µg/ml for *Streptococcus pyogenes*-442. The product 9b where -R$_1$= 2-NO$_2$, exhibited antibacterial activity 100 µg/ml for 
*Escherechia coli*- 433, 200 µg/ml for *Pseudomonas aeruginosa*-1688, 250 µg/ml for 
*Staphylococcus aureus*-96, 500 µg/ml for *Streptococcus pyogenes*-442. The product 9c where -R$_1$= 2-Cl, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 250 µg/ml for *Pseudomonas aeruginosa*-1688, 250 µg/ml for *Staphylococcus aureus*-96, 250 µg/ml for *Streptococcus pyogenes*-442.

The product 9d where -R$_1$= 4-Cl, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 200 µg/ml for *Pseudomonas aeruginosa*-1688, 200 µg/ml for 
*Staphylococcus aureus*-96, 500 µg/ml for *Streptococcus pyogenes*-442. The product 9e where -R$_1$= 4-methoxy, exhibited antibacterial activity 62.5 µg/ml for 
*Escherechia coli*- 433, 200 µg/ml for *Pseudomonas aeruginosa*-1688, 100 µg/ml for 
*Staphylococcus aureus*-96, 100 µg/ml for *Streptococcus pyogenes*-442.

The product 9f where -R$_1$= 3, 4-(OCH$_3$)$_2$, exhibited antibacterial activity 250 µg/ml for 
*Escherechia coli*- 433, 100 µg/ml for *Pseudomonas aeruginosa*-1688, 500 µg/ml for *Staphylococcus aureus*-96, 500 µg/ml for *Streptococcus
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The product 9g where \(-R_1= 2\)-methoxy, exhibited antibacterial activity 100 \(\mu\)g/ml for *Escherichia coli* - 433, 200 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 250 \(\mu\)g/ml for *Staphylococcus aureus*-96, 500 \(\mu\)g/ml for *Streptococcus pyogenes*-442.

The product 9h where \(-R_1= 4\)- Me, exhibited antibacterial activity 100 \(\mu\)g/ml for *Escherichia coli* - 433, 100 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 500 \(\mu\)g/ml for *Staphylococcus aureus*-96, 500 \(\mu\)g/ml for *Streptococcus pyogenes*-442. The product 9i where \(-R_1= 3\)-Br, exhibited antibacterial activity 250 \(\mu\)g/ml for *Escherichia coli* - 433, 250 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 250 \(\mu\)g/ml for *Staphylococcus aureus*-96, 250 \(\mu\)g/ml for *Streptococcus pyogenes*-442.

The product 9j where \(-R_1= -3,4,5\)-(OCH\(_3\))\(_3\), exhibited antibacterial activity 250 \(\mu\)g/ml for *Escherichia coli* - 433, 100 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 200 \(\mu\)g/ml for *Staphylococcus aureus*-96, 500 \(\mu\)g/ml for *Streptococcus pyogenes*-442.

5.4.4: Antibacterial activity data of \(N^2, N^4\)-bis(6-halobenzo[d]thiazol-2-yl) - N6 - (3 - substitutedphenyl)-1, 3, 5 - triazine - 2,4,6 - triamine. (Br\(_{1-12}\), Cl\(_{1-12}\)).

The product Br\(_1\) where \(-R_1= -C_6H_5\), exhibited antibacterial activity 100 \(\mu\)g/ml for *Escherichia coli* - 433, 200 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 100 \(\mu\)g/ml for *Staphylococcus aureus*-96, 500 \(\mu\)g/ml for *Streptococcus pyogenes*-442. The product Br\(_2\) where \(-R_1= -3\)-Cl-C\(_6\)H\(_4\), exhibited antibacterial activity 100 \(\mu\)g/ml for *Escherichia coli* - 433, 100 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 500 \(\mu\)g/ml for *Staphylococcus aureus*-96, 500 \(\mu\)g/ml for *Streptococcus pyogenes*-442.

The product Br\(_3\) where \(-R_1= -4\)-Cl-C\(_6\)H\(_4\), exhibited antibacterial activity 100 \(\mu\)g/ml for *Escherichia coli* - 433, 500 \(\mu\)g/ml for *Pseudomonas aeruginosa*-1688, 100 \(\mu\)g/ml for *Staphylococcus aureus*-96, 250 \(\mu\)g/ml for *Streptococcus*...
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The product $\text{Br}_4$ where $-R_1= -3\text{-NO}_2\text{-C}_6\text{H}_4$, exhibited antibacterial activity 100 µg/ml for \textit{Escherichia coli- 433}, 100 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 500 µg/ml for \textit{Staphylococcus aureus-96}, 500 µg/ml for \textit{Streptococcus pyogenes-442}. The product $\text{Br}_5$ where $-R_1= -4\text{-NO}_2\text{-C}_6\text{H}_4$, exhibited antibacterial activity 100 µg/ml for \textit{Escherichia coli- 433}, 500 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 100 µg/ml for \textit{Staphylococcus aureus-96}, 500 µg/ml for \textit{Streptococcus pyogenes-442}.

The product $\text{Br}_6$ where $-R_1= -4\text{-Br}\text{-C}_6\text{H}_4$, exhibited antibacterial activity 250 µg/ml for \textit{Escherichia coli- 433}, 500 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 00 µg/ml for \textit{Staphylococcus aureus-96}, 250 µg/ml for \textit{Streptococcus pyogenes-442}. The product $\text{Br}_7$ where $-R_1= -4\text{-F}\text{-C}_6\text{H}_4$, exhibited antibacterial activity 250 µg/ml for \textit{Escherichia coli- 433}, 500 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 100 µg/ml for \textit{Staphylococcus aureus-96}, 250 µg/ml for \textit{Streptococcus pyogenes-442}.

The product $\text{Br}_8$ where $-R_1= -2\text{-C}_5\text{H}_4\text{N}_2$, exhibited antibacterial activity 500 µg/ml for \textit{Escherichia coli- 433}, 100 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 100 µg/ml for \textit{Staphylococcus aureus-96}, 500 µg/ml for \textit{Streptococcus pyogenes-442}. The product $\text{Br}_9$ where $-R_1= -4\text{-C}_5\text{H}_4\text{N}_2$, exhibited antibacterial activity 100 µg/ml for \textit{Escherichia coli- 433}, 100 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 500 µg/ml for \textit{Staphylococcus aureus-96}, 500 µg/ml for \textit{Streptococcus pyogenes-442}.

The product $\text{Br}_{10}$ where $-R_1= -N\text{- Me}\text{-C}_6\text{H}_4$, exhibited antibacterial activity 100 µg/ml for \textit{Escherichia coli- 433}, 100 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 500 µg/ml for \textit{Staphylococcus aureus-96}, 500 µg/ml for \textit{Streptococcus pyogenes-442}. The product $\text{Br}_{11}$ where $-R_1= -4\text{- Me-C}_6\text{H}_4$, exhibited antibacterial activity 100 µg/ml for \textit{Escherichia coli- 433}, 250 µg/ml for \textit{Pseudomonas aeruginosa-1688}, 500 µg/ml for \textit{Staphylococcus aureus-96}, 500 µg/ml for \textit{Streptococcus pyogenes-442}.
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The product Br\textsubscript{12} where -R\textsubscript{1}= -4-OH-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 62.5 μg/ml for \textit{Escherechia coli}- 433, 100 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 100 μg/ml for \textit{Staphylococcus aureus}-96, 100 μg/ml for \textit{Streptococcus pyogenes}-442. The product Cl\textsubscript{1} where -R\textsubscript{1}= -C\textsubscript{6}H\textsubscript{5}, exhibited antibacterial activity 250 μg/ml for \textit{Escherechia coli}- 433, 200 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 200 μg/ml for \textit{Staphylococcus aureus}-96, 100 μg/ml for \textit{Streptococcus pyogenes}-442.

The product Cl\textsubscript{2} where -R\textsubscript{1}= -3-Cl-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 200 μg/ml for \textit{Escherechia coli}- 433, 62.5 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 125 μg/ml for \textit{Staphylococcus aureus}-96, 200 μg/ml for \textit{Streptococcus pyogenes}-442.

The product Cl\textsubscript{3} where -R\textsubscript{1}= -4-Cl-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 200 μg/ml for \textit{Escherechia coli}- 433, 250 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 200 μg/ml for \textit{Staphylococcus aureus}-96, 125 μg/ml for \textit{Streptococcus pyogenes}-442. The product Cl\textsubscript{4} where -R\textsubscript{1}= -3-NO\textsubscript{2}-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 250 μg/ml for \textit{Escherechia coli}- 433, 200 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 100 μg/ml for \textit{Staphylococcus aureus}-96, 200 μg/ml for \textit{Streptococcus pyogenes}-442.

The product Cl\textsubscript{5} where -R\textsubscript{1}= -4-NO\textsubscript{2}-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 125 μg/ml for \textit{Escherechia coli}- 433, 250 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 250 μg/ml for \textit{Staphylococcus aureus}-96, 250 μg/ml for \textit{Streptococcus pyogenes}-442. The product Cl\textsubscript{6} where -R\textsubscript{1}= -4-Br-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 200 μg/ml for \textit{Escherechia coli}- 433, 200 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 250 μg/ml for \textit{Staphylococcus aureus}-96, 250 μg/ml for \textit{Streptococcus pyogenes}-442.

The product Cl\textsubscript{7} where -R\textsubscript{1}= -4-F-C\textsubscript{6}H\textsubscript{4}, exhibited antibacterial activity 200 μg/ml for \textit{Escherechia coli}- 433, 250 μg/ml for \textit{Pseudomonas aeruginosa}-1688, 125 μg/ml for \textit{Staphylococcus aureus}-96, 250 μg/ml for \textit{Streptococcus pyogenes}-442. The product Cl\textsubscript{8} where -R\textsubscript{1}= -2-CsH\textsubscript{4}N\textsubscript{2}, exhibited antibacterial activity 125 μg/ml for \textit{Escherechia coli}- 433, 100 μg/ml for \textit{Pseudomonas
The product Cl₉ where \(-R_1=\text{-}4\text{-}C_5H_4N_2\), exhibited antibacterial activity 200 µg/ml for *Escherichia coli* - 433, 250 µg/ml for *Pseudomonas aeruginosa* - 1688, 250 µg/ml for *Staphylococcus aureus* - 96, 250 µg/ml for *Streptococcus pyogenes* - 442.

The product Cl₁₀ where \(-R_1=\text{-}N\text{-}Me-C_6H_4\), exhibited antibacterial activity 100 µg/ml for *Escherichia coli* - 433, 125 µg/ml for *Pseudomonas aeruginosa* - 1688, 250 µg/ml for *Staphylococcus aureus* - 96, 250 µg/ml for *Streptococcus pyogenes* - 442. The product Cl₁₁ where \(-R_1=\text{-}4\text{-}Me-C_6H_4\), exhibited antibacterial activity 100 µg/ml for *Escherichia coli* - 433, 200 µg/ml for *Pseudomonas aeruginosa* - 1688, 100 µg/ml for *Staphylococcus aureus* - 96, 200 µg/ml for *Streptococcus pyogenes* - 442.

The product Cl₁₂ where \(-R_1=\text{-}4\text{-}OH-C_6H_4\), exhibited antibacterial activity 125 µg/ml for *Escherichia coli* - 433, 200 µg/ml for *Pseudomonas aeruginosa* - 1688, 250 µg/ml for *Staphylococcus aureus* - 96, 100 µg/ml for *Streptococcus pyogenes* - 442.

5.4.5: Antifungal activity data of 4-(substitutedbenzylidene)-2-(substitutedphenyl)-1,3-oxazol-5(4H)-ones. (4a-j, 7a-j). Data Table: 11-14

**Minimal fungicidal concentration in µg / ml**

The standard drug Nystain exhibited antifungal activity 100 µg/ml for *C. albicans* - 227, 100 µg/ml for *A. nigar* - 282, 100 µg/ml for *A. clavatus* - 1323. The standard drug Griseofulvin exhibited antifungal activity 500 µg/ml for *C. albicans* - 227, 100 µg/ml for *A. nigar* - 282, 100 µg/ml for *A. clavatus* - 1323.

The product 4a where \(-R_1=\text{-}H\), exhibited antifungal activity 200 µg/ml for *C. albicans* - 227, >1000 µg/ml for *A. nigar* - 282, 250 µg/ml for *A. clavatus* - 1323. The product 4b where \(-R_1=\text{2\text{-}NO}_2\), exhibited antifungal activity 200 µg/ml for *C. albicans* - 227, >1000 µg/ml for *A. nigar* - 282, >1000 µg/ml for *A. clavatus* - 1323. The product 4c where \(-R_1=\text{2\text{-}Cl}\), exhibited antifungal activity 500 µg/ml.
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for \(C.\) albicans-227, >1000 \(\mu\)g/ml for \(A.\) nigar-282, >1000 \(\mu\)g/ml for \(A.\) clavatus-1323.

The product 4d where -\(R_1\)= 4-Cl, exhibited antifungal activity 250 \(\mu\)g/ml for \(C.\) albicans-227, 62.5 \(\mu\)g/ml for \(A.\) nigar-282, 500 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 4e where -\(R_1\)= 4-methoxy, exhibited antifungal activity 200 \(\mu\)g/ml for \(C.\) albicans-227, 1000 \(\mu\)g/ml for \(A.\) nigar-282, 250 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 4f where -\(R_1\)= 3, 4-(OCH\(_3\))\(_2\), exhibited antifungal activity 100 \(\mu\)g/ml for \(C.\) albicans-227, 250 \(\mu\)g/ml for \(A.\) nigar-282, 200 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 4g where -\(R_1\)= 2-methoxy, exhibited antifungal activity 100 \(\mu\)g/ml for \(C.\) albicans-227, 1000 \(\mu\)g/ml for \(A.\) nigar-282, 62.5 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 4h where -\(R_1\)= 4- Me, exhibited antifungal activity 250 \(\mu\)g/ml for \(C.\) albicans-227, 500 \(\mu\)g/ml for \(A.\) nigar-282, 100 \(\mu\)g/ml for \(A.\) clavatus-1323.

The product 4i where -\(R_1\)= 3-Br, exhibited antifungal activity 1000 \(\mu\)g/ml for \(C.\) albicans-227, 250 \(\mu\)g/ml for \(A.\) nigar-282, 500 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 4j where -\(R_1\)= 3,4,5-(OCH\(_3\))\(_3\), exhibited antifungal activity 200 \(\mu\)g/ml for \(C.\) albicans-227, 62.5 \(\mu\)g/ml for \(A.\) nigar-282, 500 \(\mu\)g/ml for \(A.\) clavatus-1323.

The product 7a where -\(R_1\)= -H, exhibited antifungal activity 250 \(\mu\)g/ml for \(C.\) albicans-227, >1000 \(\mu\)g/ml for \(A.\) nigar-282, >1000 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 7b where -\(R_1\)= 2-NO\(_2\), exhibited antifungal activity 62.5 \(\mu\)g/ml for \(C.\) albicans-227, 500 \(\mu\)g/ml for \(A.\) nigar-282, 1000 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 7c where -\(R_1\)= 2-Cl, exhibited antifungal activity 250 \(\mu\)g/ml for \(C.\) albicans-227, >1000 \(\mu\)g/ml for \(A.\) nigar-282, >1000 \(\mu\)g/ml for \(A.\) clavatus-1323.

The product 7d where -\(R_1\)= 4-Cl, exhibited antifungal activity 250 \(\mu\)g/ml for \(C.\) albicans-227, 500 \(\mu\)g/ml for \(A.\) nigar-282, 250 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 7e where -\(R_1\)= 4-methoxy, exhibited antifungal activity 100 \(\mu\)g/ml for \(C.\) albicans-227, 250 \(\mu\)g/ml for \(A.\) nigar-282, 250 \(\mu\)g/ml for \(A.\) clavatus-1323. The product 7f where -\(R_1\)= 3, 4-(OCH\(_3\))\(_2\), exhibited antifungal activity 1000
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μg/ml for *C. albicans*-227, 200 μg/ml for *A. niger*-282, 250 μg/ml for *A. clavatus*-1323.

The product 7g where -R₁= 2-methoxy, exhibited antifungal activity 250 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323. The product 7h where -R₁= 4- Me, exhibited antifungal activity 200 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 100 μg/ml for *A. clavatus*-1323. The product 7i where -R₁= 3-Br, exhibited antifungal activity 200 μg/ml for *C. albicans*-227, 62.5 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 7j where -R₁= 3,4,5-(OCH₃)₃, exhibited antifungal activity 100 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323.

5.4.6: Antibacterial activity data of 4-(substitutedbenzylidene)-2-(3-Mephenyl)-1-(substitutedphenyl)-4H-imidazol-5-ones. (5a-j, 6a-j)

The product 5a where -R₁= -H, exhibited antifungal activity 500 μg/ml for *C. albicans*-227, 1000 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 5b where -R₁= 2-NO₂, exhibited antifungal activity 62.5 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 5c where -R₁= 2-Cl, exhibited antifungal activity 100 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 250 μg/ml for *A. clavatus*-1323. The product 5d where -R₁= 4-Cl, exhibited antifungal activity 100 μg/ml for *C. albicans*-227, 1000 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323. The product 5e where -R₁= 4-methoxy, exhibited antifungal activity 62.5 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 5f where -R₁= 3, 4-(OCH₃)₂, exhibited antifungal activity 500 μg/ml for *C. albicans*-227, 1000 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 5g where -R₁= 2-methoxy, exhibited antifungal activity 250 μg/ml for *C.albicans*-227, >1000 μg/ml for *A. niger*-282, >1000 μg/ml for *A. clavatus*-1323. The product 5h where -R₁= 4- Me, exhibited antifungal activity 1000 μg/ml for *C.albicans*-227, 500 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323. The product 5i where -R₁= 3-Br, exhibited
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antifungal activity 100 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 5j where \( -R_1 = 3,4,5-(OCH_3)_3 \), exhibited antifungal activity 100 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323. The product 6a where \( -R_1 = -H \), exhibited antifungal activity 100 μg/ml for *C. albicans*-227, 1000 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323. The product 6b where \( -R_1 = 2-NO_2 \), exhibited antifungal activity 250 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323.

The product 6c where \( -R_1 = 2-Cl \), exhibited antifungal activity 62.5 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 250 μg/ml for *A. clavatus*-1323. The product 6d where \( -R_1 = 4-Cl \), exhibited antifungal activity 250 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 100 μg/ml for *A. clavatus*-1323. The product 6e where \( -R_1 = 4\text{-methoxy} \), exhibited antifungal activity 1000 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 250 μg/ml for *A. clavatus*-1323. The product 6f where \( -R_1 = 3, 4-(OCH_3)_2 \), exhibited antifungal activity 1000 μg/ml for *C.albicans*-227, 200 μg/ml for *A. niger*-282, 200 μg/ml for *A. clavatus*-1323. The product 6g where \( -R_1 = 2\text{-methoxy} \), exhibited antifungal activity 1000 μg/ml for *C.albicans*-227, 250 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 6h where \( -R_1 = 4\text{- Me} \), exhibited antifungal activity 62.5 μg/ml for *C.albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 6i where \( -R_1 = 3\text{-Br} \), exhibited antifungal activity 100 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 200 μg/ml for *A. clavatus*-1323. The product 6j where \( -R_1 = 3,4,5-(OCH_3)_3 \), exhibited antifungal activity 250 μg/ml for *C. albicans*-227, >1000 μg/ml for *A. niger*-282, >1000 μg/ml for *A. clavatus*-1323.

5.4.7: Antibacterial activity data of 4-(substitutedbenzylidene)-2-(4-chlorophenyl)-1-(substitutedphenyl)-4H-imidazol-5-ones. (8a-j, 9a-j)

The product 8a where \( -R_1 = -H \), exhibited antifungal activity 500 μg/ml for *C. albicans*-227, 250 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product 8b where \( -R_1 = 2-NO_2 \), exhibited antifungal activity 250 μg/ml for *C.
albicans-227, 500 μg/ml for A. niger-282, 250 μg/ml for A. clavatus-1323. The product 8c where -R₁= 2-Cl, exhibited antifungal activity 1000 μg/ml for C. albicans-227, 250 μg/ml for A. niger-282, 500 μg/ml for A. clavatus-1323. The product 8d where -R₁= 4-Cl, exhibited antifungal activity 100 μg/ml for C. albicans-227, 500 μg/ml for A. niger-282, 1000 μg/ml for A. clavatus-1323. The product 8e where -R₁= 4-methoxy, exhibited antifungal activity 500 μg/ml for C. albicans-227, >1000 μg/ml for A. niger-282, >1000 μg/ml for A. clavatus-1323. The product 8f where -R₁= 3, 4-(OCH₃)₂, exhibited antifungal activity 500 μg/ml for C. albicans-227, >1000 μg/ml for A. niger-282, >1000 μg/ml for A. clavatus-1323.

The product 8g where -R₁= 2-methoxy, exhibited antifungal activity 100 μg/ml for C. albicans-227, 500 μg/ml for A. niger-282, 1000 μg/ml for A. clavatus-1323. The product 8h where -R₁= 4- Me, exhibited antifungal activity 250 μg/ml for C. albicans-227, >1000 μg/ml for A. niger-282, >1000 μg/ml for A. clavatus-1323. The product 8i where -R₁= 3-Br, exhibited antifungal activity 62.5 μg/ml for C. albicans-227, 250 μg/ml for A. niger-282, 500 μg/ml for A. clavatus-1323. The product 8j where -R₁= 3,4,5-(OCH₃)₃, exhibited antifungal activity 500 μg/ml for C. albicans-227, 200 μg/ml for A. niger-282, 500 μg/ml for A. clavatus-1323. The product 9a where -R₁= -H, exhibited antifungal activity 1000 μg/ml for C. albicans-227, 250 μg/ml for A. niger-282, 250 μg/ml for A. clavatus-1323.

The product 9b where -R₁= 2-NO₂, exhibited antifungal activity 500 μg/ml for C. albicans-227, >1000 μg/ml for A. niger-282, >1000 μg/ml for A. clavatus-1323. The product 9c where -R₁= 2-Cl, exhibited antifungal activity 100 μg/ml for C. albicans-227, 500 μg/ml for A. niger-282, 500 μg/ml for A. clavatus-1323. The product 9d where -R₁= 4-Cl, exhibited antifungal activity 1000 μg/ml for C. albicans-227, >1000 μg/ml for A. niger-282, >1000 μg/ml for A. clavatus-1323. The product 9e where -R₁= 4-methoxy, exhibited antifungal activity 250 μg/ml for C. albicans-227, 100 μg/ml for A. niger-282, 500 μg/ml for A. clavatus-1323.
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The product Br₁ where -R₁= -C₆H₅, exhibited antifungal activity 500 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product Br₂ where -R₁= -3-Cl-C₆H₄, antifungal activity 200 μg/ml for *C. albicans*-227, 200 μg/ml for *A. niger*-282, 200 μg/ml for *A. clavatus*-1323. The product Br₃ where -R₁= -4-Cl-C₆H₄, antifungal activity 100 μg/ml for *C. albicans*-227, 100 μg/ml for *A. niger*-282, 100 μg/ml for *A. clavatus*-1323. The product Br₄ where -R₁= -3-NO₂-C₆H₄, antifungal activity 100 μg/ml for *C. albicans*-227, 100 μg/ml for *A. niger*-282, 100 μg/ml for *A. clavatus*-1323. The product Br₅ where -R₁= -4-NO₂-C₆H₄, antifungal activity 500 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product Br₆ where -R₁= -4-Br-C₆H₄, antifungal activity 100 μg/ml for *C. albicans*-227, 100 μg/ml for *A. niger*-282, 100 μg/ml for *A. clavatus*-1323. The product Br₇ where -R₁= -4-F-C₆H₄, antifungal activity 500 μg/ml for *C. albicans*-227, 1000 μg/ml for *A. niger*-282, 1000 μg/ml for *A. clavatus*-1323. The product Br₈ where -R₁= -2-C₅H₄N₂, antifungal activity 500 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323. The product Br₉ where -R₁= -4-C₅H₄N₂, antifungal activity 500 μg/ml for *C. albicans*-227, 500 μg/ml for *A. niger*-282, 500 μg/ml for *A. clavatus*-1323.

5.4.8: Antibacterial activity data of N², N⁴-bis(6-halobenzo[d]thiazol-2-yl) -N6 - (3 - substitutedphenyl-1, 3, 5 - triazine- 2,4,6-triamine. (Br₁₋₁₂, Cl₁₋₁₂).
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The product Br$_10$ where -R$_1$= -N- Me-C$_6$H$_4$, antifungal activity 200 µg/ml for *C. albicans*-227, 200 µg/ml for *A. niger*-282, 200 µg/ml for *A. clavatus*-1323. The product Br$_{11}$ where -R$_1$= -4- Me-C$_6$H$_4$, antifungal activity 500 µg/ml for *C. albicans*-227, 500 µg/ml for *A. niger*-282, 500 µg/ml for *A. clavatus*-1323. The product Br$_{12}$ where -R$_1$= -4-OH-C$_6$H$_4$, antifungal activity 62.5 µg/ml for *C. albicans*-227, 100 µg/ml for *A. niger*-282, 100 µg/ml for *A. clavatus*-1323. The product Cl$_1$ where -R$_1$= -C$_6$H$_5$, antifungal activity 500 µg/ml for *C. albicans*-227, 250 µg/ml for *A. niger*-282, 250 µg/ml for *A. clavatus*-1323. The product Cl$_2$ where -R$_1$= -3-Cl-C$_6$H$_4$, antifungal activity 1000 µg/ml for *C. albicans*-227, 250 µg/ml for *A. niger*-282, 200 µg/ml for *A. clavatus*-1323.

The product Cl$_3$ where -R$_1$= -4-Cl-C$_6$H$_4$, antifungal activity 250 µg/ml for *C. albicans*-227, 500 µg/ml for *A. niger*-282, 100 µg/ml for *A. clavatus*-1323. The product Cl$_4$ where -R$_1$= -3-NO$_2$-C$_6$H$_4$, antifungal activity 1000 µg/ml for *C. albicans*-227, 500 µg/ml for *A. niger*-282, 62.5 µg/ml for *A. clavatus*-1323. The product Cl$_5$ where -R$_1$= -4-NO$_2$-C$_6$H$_4$, antifungal activity 1000 µg/ml for *C. albicans*-227, 500 µg/ml for *A. niger*-282, 500 µg/ml for *A. clavatus*-1323. The product Cl$_6$ where -R$_1$= -4-Br-C$_6$H$_4$, antifungal activity 62.5 µg/ml for *C. albicans*-227, 250 µg/ml for *A. niger*-282, 500 µg/ml for *A. clavatus*-1323. The product Cl$_7$ where -R$_1$= -4-F-C$_6$H$_4$, antifungal activity >1000 µg/ml for *C. albicans*-227, 1000 µg/ml for *A. niger*-282, 250 µg/ml for *A. clavatus*-1323. The product Cl$_8$ where -R$_1$= -2-C$_5$H$_4$N$_2$, antifungal activity 500 µg/ml for *C. albicans*-227, 1000 µg/ml for *A. niger*-282, 500 µg/ml for *A. clavatus*-1323. The product Cl$_9$ where -R$_1$= -4-C$_5$H$_4$N$_2$, antifungal activity 100 µg/ml for *C. albicans*-227, 250 µg/ml for *A. niger*-282, 250 µg/ml for *A. clavatus*-1323. The product Cl$_{10}$ where -R$_1$= -N- Me-C$_6$H$_4$, antifungal activity 500 µg/ml for *C. albicans*-227, >1000 µg/ml for *A. niger*-282, 500 µg/ml for *A. clavatus*-1323.

The product Cl$_{11}$ where -R$_1$= -4- Me-C$_6$H$_4$, antifungal activity 62.5 µg/ml for *C. albicans*-227, 500 µg/ml for *A. niger*-282, 250 µg/ml for *A. clavatus*-1323. The product Cl$_{12}$ where -R$_1$= -4-OH-C$_6$H$_4$, antifungal activity 1000 µg/ml for *C. albicans*-227, 250 µg/ml for *A. niger*-282, 1000 µg/ml for *A. clavatus*-1323.