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(REVIEW ARTICLE)

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A review: Synthesis characterization and *in vitro* anti-mycobacterial activity of some novel benzothiazole

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Abstract

Heterocyclic compounds, analogs, and derivatives have received a lot of interest recently because of their advantageous biological and pharmacological properties. Flexible substrates include the heterocyclic compounds that benzothiazole and its analogs can be used to synthesize. The benzothiazole nucleus is utilized to create a wide variety of pharmaceuticals. The biological activity of benzothiazole derivatives has recently undergone some intriguing alterations. These compounds stand out in the world of medicinal chemistry due to their high pharmacological potential. According to the World Health Organisation, Mycobacterium tuberculosis is the most dangerous chronic disease that can spread. The spread of Mycobacterium tuberculosis resistance is a serious issue. The examined bacterial strains were only partially and ineffectively active. Mycobacterium tuberculosis (Mtb), the bacterium that causes human tuberculosis (TB), is more common in multidrug-resistant strains, which is one of the main factors driving the development of new drugs to treat this variety of diseases. They have also been subjected to a traditional method of testing for their antibacterial and antifungal qualities. According to the outcomes of the activities, compounds exhibited moderate to good antibacterial and antifungal activity.

Keywords: Mycobacterium tuberculosis; Benzothiazole; Antitubercular activity; Synthesis; Tuberculosis

1. Introduction

Fever, exhaustion, and chest pain are some of the symptoms of the lung condition known as tuberculosis (TB), which is caused by Mycobacterium tuberculosis [1]. virus, which infects around a third of the world's population, is thought to be the cause of two million deaths annually[2]. Recent years have seen a substantial increase in TB cases, which is a result of two important factors. First, infections are more likely to affect people with acquired immunodeficiency. TB increases the likelihood of developing the condition by 100 times In addition, there has been an increase of disease-resistant strains, some of which exhibit cross-resistance to several drugs [3]. For short-course therapies, various combinations of isoniazid, rifampicin, pyrazinamide, Ethambutol, and streptomycin are currently used as first-line drugs. However, inadequate dosage, prolonged administration, and subpar patient compliance led to the emergence of drug-resistant strains. Multi-drug-resistant tuberculosis is a form of the disease that does not respond to first-line treatments. Multi-drug resistant TB patients made up approximately 3.3% of all new cases in 2009, according to estimates. According to estimates, multi-drug-resistant TB patients made up about 3.3% of all new cases in 2009 [4]. Thus, there is an urgent need for new anti-TB medications, particularly ones with shorter

These compounds have caught the interest of chemists and biologists due to the range of their physicochemical and pharmacological activities. Theoretical ramifications, variability of the synthetic process, physiological ramifications, and practical applications are all equally fascinating. Synthetic heterocyclic chemistry has had an impact on almost every

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element of human life, and heterocyclic compounds have been used in a variety of applications, including agriculture, plastics, medicine, and other sectors [5].

Many naturally occurring medications are heterocyclic in origin, including morphine, codeine, papaverine, theophylline, procaine, reserpine, quinine, atropine, and emetine. The bulk of synthetic pharmaceuticals, in addition to being heterocyclic compounds, include isoniazid (INH), diazepam, metronidazole, chlorpromazine, barbiturates, captopril, methotrexate, azidothymidine, and antipyrine. Heterocyclic molecules are essential components of the chemicals that support life.

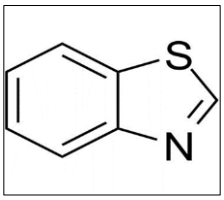


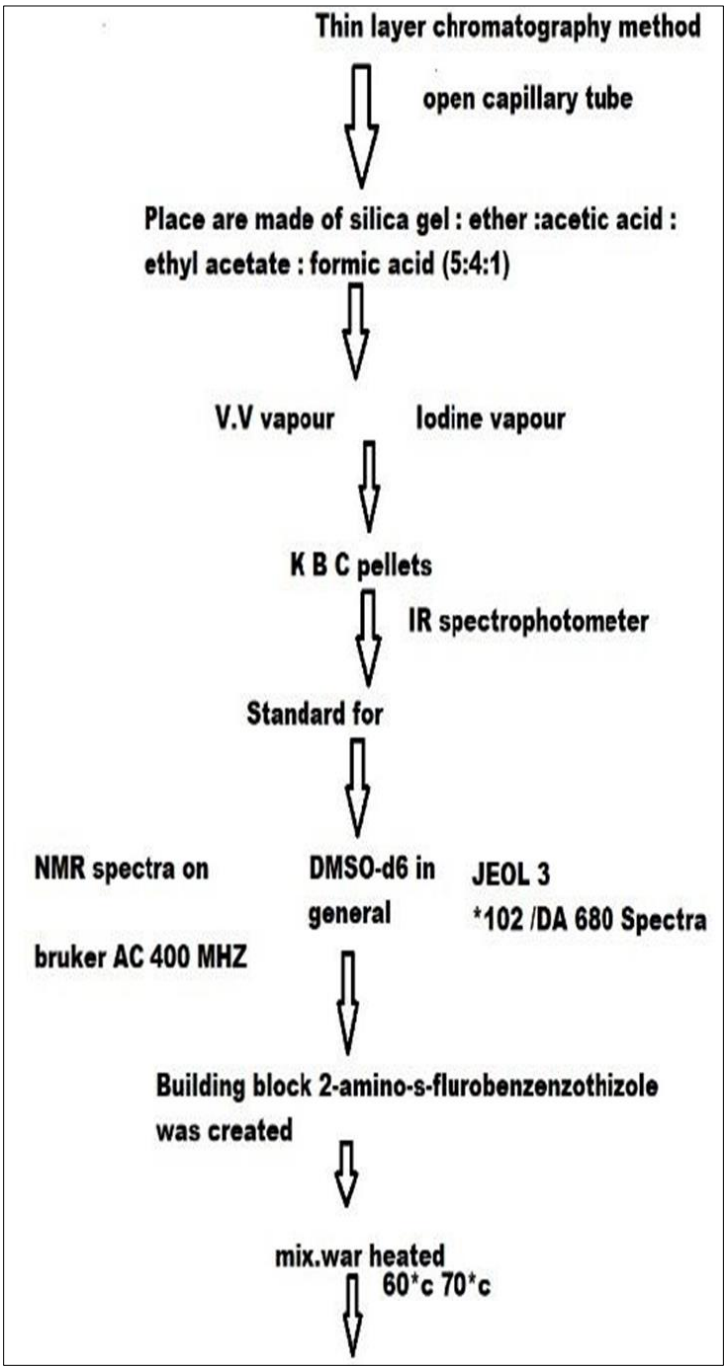
Figure 1 Stucture of benzothiazole nucleus

2. Chemistry benzothiazole nucleus

A heterocyclic molecule called benzothiazole is employed in research as a building block for the synthesis of more substantial chemicals, usually bioactive ones. Its aromaticity makes it rather stable while having reactive sites like a heterocycle, which facilitate functionalization. Benzothiazole is an inert, mildly viscous liquid with melting and boiling temperatures of 2 °C and 227–228 °C, respectively. The molecular weight of benzothiazole is 139.19 $nmol^{-1}$, and its density is 1.644 gm/ml. The benzothiazole has no domestic usage.

It is applied in both science and business. The benzothiazole nucleus has medicinal use. Many different types of therapeutic drugs are synthesized using the benzothiazole nucleus. The biological activity of benzothiazole derivatives has recently undergone some intriguing alterations. These compounds stand out in the realm of medicinal chemistry due to their outstanding pharmacological potential. Benzothiazoles are a vital component of chemicals that are frequently found as physiologically active natural products as well as in the method. alterations. These compounds stand out in the realm of medicinal chemistry due to their outstanding pharmacological potential. Benzothiazoles are a vital component of chemicals that are frequently found as physiologically active natural products as well as in the method.

3. Material and methods



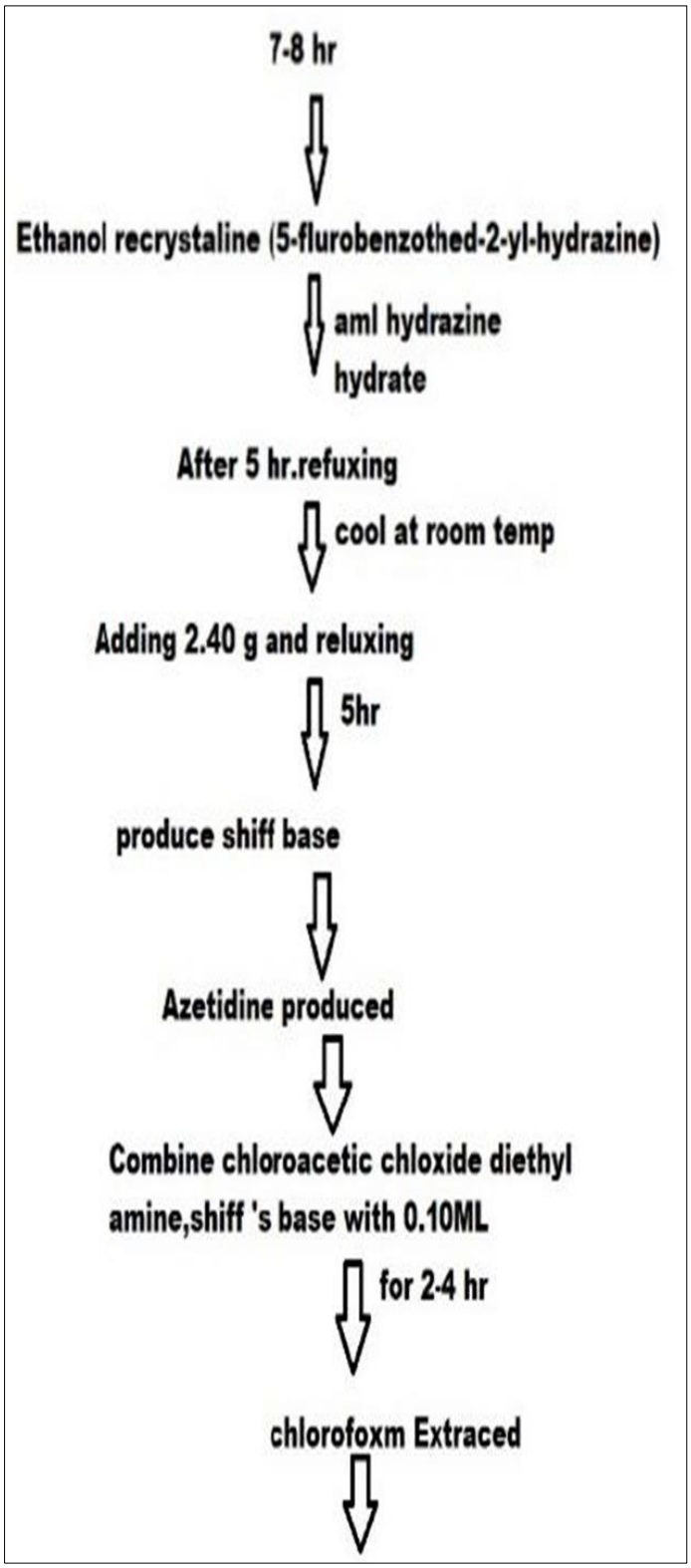


Figure 2 Matrial and method of benzothiazole

4. Chemistry

All of the laboratory-grade chemicals were given by E. Merck (Germany) and S.D. Fine Chemicals (India). The uncorrected melting points of all synthesized compounds were determined by the Open Tube Capillary Method. Thin-layer chromatography plates were created using Silica Gel in order to keep track of the reactions, verify the purity of

the synthesized chemicals, and verify the calibre of the commercial reagents. There are two different solvent systems: toluene: ethyl acetate: formic acid (5:4:1) and petroleum ether: toluene: acetic acid (5:4:1). Two different solvent systems include toluene, ethyl acetate, formic acid (5:4:1), and petroleum ether. Toluene and acetic acid were used in a 5:4:1 ratio to run the thin-layer chromatography. The dots were visible when UV and iodine vapour were present. The IR spectra were recorded using a Perkin Elmer 1720 FT-IR. spectrophotometer using KBr pellets. The internal standard for NMR spectra in CDCl3 and DMSO-d6 on the Bruker AC 400 MHz was TMS. The FAB mass spectra were gathered using a JEOL SX 102/DA 6000 mass spectrometer. The laboratory chemicals were supplied by Chemises Chemical Ltd. (Rajkot, India).[6]

The synthesized compounds' uncorrected open capillary melting points were tested. The IR spectra were recorded on a KBr disc using a NICOLET iS10 spectrophotometer from Thermal Scientific. On a 400 MHz spectrophotometer, re-recorded 1 H NMR spectra were produced using DMSO-d6 as the solvent and TMS as an internal standard. The purity of the compounds was checked using TLC. The computed values matched the elemental analyses of all the components. The Lowenstein-Jensen approach was used to evaluate the antitubercular activity at Micro pharm Gandhi-nagar in Gujarat, India [7].

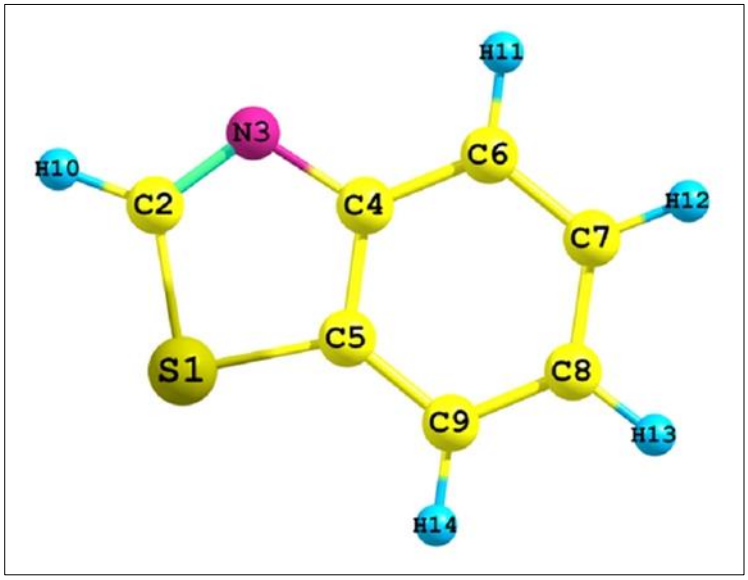


Figure 3 Molecular structure of benzothiazole

The building block 2-amino-5-fluorobenzothiazole [2.023a-c] was produced using the methods previously discussed. Using a standard technique, ethyl (5-fluorobenzothiazol-2-yl) carbamate 2-amino benzothiazole (0.066 moles) was synthesized. 2 g of anhydrous K2CO3, 13.5 g, 30 mL of pure ethanol, and 0.0064 mole of ethyl chloroformate 0.7 g were blended between 0°C and 5°C. For 7-8 hours, the mixture was heated at 60°C to 70°C. The combination was filtered, the solvent evaporated under reduced pressure to produce the product as a solid, and ethanol was used to re-crystallize the product (5-fluorobenzothiazol-2-yl). typically synthesized from 5-fluorobenzothiazol-2-yl hydrazine carboxamide 30 mL of ethanol was used to dissolve 5.5 g of ethyl (0.021 mole) carbamate after it had been treated with 4 mL of hydrazine hydrate.

The reaction mixture was cooled to room temperature after 5 hours of refluxing. Following the separation of the products, the leftover material was washed with ethanol and crystallized. created with ethanol. generic synthetic procedure for substituted benzaldehyde Semicarbazone (0.02 mole) N-(5-fluorobenzothiazol-2-yl) The carboxamide of N-(6-fluorobenzothiazol-2-yl)hydrazine 5.21 g were dissolved in 100% ethanol and replaced with benzaldehyde (0.02 mole). In order to create a Schiff base, 2.40 g was added, and it was then refluxed for three hours before the solvent was removed under reduced pressure. Schiff bases can typically be used to generate azetidinones.

1-(3-chloro-2-oxo-4-(p-methoxyphenyl) azetidine-1-yl)(A6) -3-(5-fluoro-benzothiazol-2-yl)urea Yield: 80%; mp: 175 °C; IR (KBr) v cm-1: 3095 (NH), 1675 (C=O), 1605 (C=N, C=C), 720 (C-S), and 680 (C-Cl); and 1 H NMR (DMSO-d6) 2.95 (s, 3H, OCH3), 3.95 (s, 1H, azetidinones C4 -H), 4.23 (s, 1H, azetidin C3-H), 6.00 (s, 1H, N1-H), 7.68-? (m, 7H, Ar -H), and 8.45 (s, 1H, N3-H) are the concentrations in parts per million (ppm). C, 51.37; H, 3.35; and N, 13.31 are the analytic values for C18H14ClFN4O3 S. Found were: C, 51.35; H, 3.36; and N, 13.29%.3-(5-fluorobenzothiazolidin-1-yl)-1-(3-

chloro-2-oxo-4-phenylazetidin-1-yl)urea (A7).Yield: 77%; IR (KBr) at 162 °C: 3010 (NH), 1680, 1650 (C=O), 1601 (C=N, C=C), 1152 (C-F), 725 (C-S), and 1 H NMR (DMSO-d6) (ppm): 4.3 (3H, -OCH3), 3.95 (1H, CH-Cl), 7.58-? (m, 8H, Ar- H), 8.47 (1H, CONH), and 11.75 (1H, NH). Analytical calculations were made for C17H12ClF-N4 O2 S and the resulting values were C, 52.23, H, 3.08, and N, 14.33%.3-(Chloro-2-oxo-4-(m-tolyl) azetidin-1-yl)5-(fluorobenzo[d] thiazol-2-yl)urea (A8)yield 87%, melting point 150 °C, and IR (KBr) v cm-1: 3092 (NH).

The following values were calculated for C18H14ClFN4 O2 S: C, 53.40; H, 3.49; N, 13.84. 1610 (C=N), 1150 (C-F); 1 H NMR (DMSO-d6) (ppm): 2.18 (s, 1H, CH3), 11.34 (S, 1H, NH), 8.72 (s, 1H, CONH). Found were: C, 53.39; H, 3.38; and N, 13.83%.3-Chloro-2-oxo-4-(o-tolyl) azetidin-1-ylThe chemical name for this compound is A9. Yield 88%; mp 195°C; IR(KBr) v cm-1: 1674 (C=O), 3094(NH), 1604 (C=N), 1157(C-F), 728 (C-S), 1685(C=C); 1 HNMR (DMSO-d6) δ (ppm): 2.16 (s, 1H, CH3), 11.34 (s, 1H, NH), 3.57 (s, 1H, azetidin C4-H),), 5.64 (s, 1H, CH-Cl), 8.77 (s, 1H, CONH). Anal. calculated values for C18H14ClFN4 O2 S are 53.40, 3.49, and 13.84. Found were: C, 53.38; H, 3.38; and N, 13.82%.3-(5-fluorobenzo[d])-1-(3-chloro-2-oxo-4-(o-methoxide) azetidin-1-yl) Yield 88%; mp 195 °C; IR(KBr) v cm-1: 1674 (C=O), 3094(NH), 1604 (C=N), 1157(C-F), 728 (C-S), 1685(C=C); 1 HNMR (DMSO-d6) δ (ppm): 2.16 (s, 1H, CH3), 11.34 (s, 1H, NH), 3.57 (s, 1H, azetidin C4-H),), 5.64 (s, 1H, CH-Cl), 8.77 (s, 1H, CONH). Anal. calculated for C18H14ClFN4O2S: C, 53.40; H, 3.49; N, 13.84; found: C, 53.38; H, 3.38; N, 13.82%.

3-(5-fluorobenzo[d] thiazol-2-yl)urea (1-(3-chloro-2-oxo-4-(o-methoxide) azetidin-1-yl)) (A10) Yield: 85%; melting point: 180 °C; IR(KBr) v cm-1: 1674 (C=O), 3093 (NH), 1600 (C=N), 1150 (C-F), 725 (C-S), 1650 (C=C); 1HNMR (DMSO-d6) (ppm): 3.89 (s, 3H, -OCH3 4.25 (s, 1H, azetidin C3), 9.44(s, 1H, NH), 8.45 (s, 1H, CONH), 4.15 (s, 1H, CH-Cl). Calc. anal as C18H14ClFN4 O3S: C, 51.37; H, 3.35; N, 13.31. discovered: C, 51.36; H

5. General procedure

The 1 H and 13C nuclear magnetic resonance (NMR) spectra in CDCl3-d were recorded on a Bruker Advance TM III 600 spectrometer at frequencies of 600 and 150.913 MHz, respectively. Chemical shifts are quantified in parts per million (ppm) using the last proton of the solvent. High resolution mass spectrometry (HRMS) measurements were performed on a Bruker MicroTOF Q II mass spectrometer with an APCI source set at 200 or 180 °C, respectively, using Bruker Compass Data Analysis 4.0 software [8].

A full scan from 50–1500 m/z was performed at these voltages: 4500 V for the capillary, 500 V for the end plate offset, and 100 Vpp for the collision cell RF.s as a standard. The nebulizer was adjusted to 1.6 and 0.4 Bar, respectively. The dividing pattern has the following abbreviations: A singlet (s), a doublet (d), a doublet of doublets (dd), a doublet of triplets (dt), a triplet (t), a triplet of triplets (tt), a quadruplet of doublets (Qd), and a multiple (m) are the four different types of births. High resolution mass spectrometry (HRMS) data were gathered using a Bruker MicroTOF Q II mass spectrometer.

6. Methods of characterization

The synthesized compounds were identified by using the following methods.

- **Melting Point**: The melting points of the compounds were determined by the capillary tube method.
- **Thin Layer Chromatography**: Pre-coated TLC plates with silica gel GF 250 were used. Samples of reactants and products were prepared with suitable solvents. Solvent system was prepared based on the nature of the compounds.
  - **Stationary phase** : Pre coated gel plate (silica gel GF 250)
  - **Mobile phase** : Ethyl acetate: Hexane (4:6) ; Pet ether : Ethyl acetate (1:4)
  - **Visualizing agent**: Iodine chamber.
  - The determination of the Rf value of the reactants and the final product was done.
  - The characterization was carried out using sophisticated methods like
  - Infrared spectroscopy, Nuclear magnetic resonance spectroscopy and Mass spectroscopy.
- **Infra-Red Absorption Spectroscopy**: IR (region 2.5-15) is a powerful tool for identifying the pure organic and inorganic compounds, with the exception of a few homo nuclear molecules such as O2, N2, Cl2 all the molecular species absorb infrared radiation.
  - **Instrument : FT-IR spectrophotometer (model no: 3000)**
  - **Sample technique: KBr Pellet technique.**
- **NMR Spectroscopy**: Nuclear magnetic resonance involves the interaction between oscillating magnetic field of electromagnetic radiation and the magnetic energy of the hydrogen Q-T of-Mass Spectroscopy (Q-T of micro

hybrid quadrupole Time of flight mass spectrometer) with electro spray ionization and in JEOL GCMATE II GC-MS. or some other type of nuclei when these are placed in an external static magnetic field. NMR enables us to study the number of equivalent protons and their electronic environment. It reveals the different chemical environment in which the proton is present and helps us to ascertain the structure of molecule.

- The number of signals in an NMR spectrum denotes the number of the set of equivalent protons in a molecule. The position of the signals in the spectrum helps us to know the nature of protons such as aromatic, aliphatic, acetylenes, vinyl, adjacent to some electron attracting or electron-releasing group etc.
- Instrument used: BRUKER Advance 500 NMR spectrometer
- Solvent: Deuterated Dimethyl Sulphoxide
- Internal standard: Tetramethylsilane(TMS).

- **Mass Spectroscopy**: Mass spectroscopy is an analytical technique used to establish the molecular weight and help in the determination molecular structure of theanalyse under investigation. In this technique, the compound under investigation is bombarded with a beam of electrons producing ionic fragments of the original species. The relative abundance of the fragment ion formed depends on the stability of the ion and of the lost radical. The resulting charged particles are then separated according to their masses. Each kind of ion has a particular ratio of mass to charge, i.e. m/z ratio (value). Mass spectrum is a record of information regarding various masses produced and their relative abundances.
- **LC-MS**: Liquid chromatography with mass spectroscopy is used to characterize the non-volatile compounds but GC-MS is used to characterize only the volatile compounds.
- Q-T of-Mass Spectroscopy (Q-T of micro hybrid quadrupole Time of flight mass spectrometer) with electro spray ionization and in JEOL GCMATE II GC-MS.

7. Characterization

The FTIR spectra of the final products showed the absence of the parent functional group and the presence of the new functional group, C=NH. For all the synthesized compounds, the usual peak for C=NH stretching at 1450.34cm-1 was obtained. The synthesized compounds' IR absorption showed evidence of aliphatic CH stretching vibration at a wavelength of 2923.87 cm-1. Aromatic CH stretching vibrations between 3080 and 3030 cm-1 and NH stretching vibrations between 3500-3390 cm-1 were observed in all of the compounds. The Nitro group was visible as a distinct band at 1512.08 cm-1 in Compound 1's absorption spectrum. The 1HNMR spectra of several derivatives revealed a signal at -8.4 indicating the presence of an aromatic ring and bands around it [9].

7.1. Synthesis of 1-[4-(4-hydroxyphenyl)-2-methyl-4H-pyrimido[2,1-b][1,3] benzothiazol-yl] ethanone (1a, C19H16N2O3S)

Yield: 67%; Melting point :198-2000C. IR (KBr, cm-1) :3440cm-1 (OH),2923 cm-1 (CH), 1735 cm-1 (C=O), 1488 cm-1 (C=N). 1H-NMR (DMSO- d6) δ ppm: 9.9(s, 1H, OH), 6.7-8 (m, 8H, Ar-H), 2.5(d, 2H, CH3), 1.1-1.3(m, 4H, CH3), MS (m/z): 337.17(M+); Anal. Clad. For C19H16N2O3S (336.41): C67.84, H 4.79, N 8.33. Found: (337.17) C 67.43, H 5.36, N 8.28.Synthesis of 2-(2H-pyrimido[2,1-b][1,3]benzothiazol-4-yl)phenol(1b, C16H12N2OS): Yield : 59% ; Melting Point : 115-1170C. IR (KBr, cm-1): 3433 cm-1(OH), 2923 cm-1 (CH), 2352 cm-1 (NH), 1643 cm-1 (C=C), 1450 cm-1 (C=N). 1H-NMR (DMSO- d6) ppm: 8.8(s, 1H, OH), 7.9(d, 1H, CH), 7.7 -8.0(d, 2H, CH), 7.1-7.5(m, 7H, Ar-H), 4.1(s, 2H, CH). MS (m/z): 279.29(M-1) Anal. Clad. For C16H12N2OS (280.34): C 68.55, H 4.31, and N 9.99. Found: (279.29) C 68.80, H 3.97, N 10.03.

7.2. Synthesis of Ethyl 4-(4-hydroxyphenyl)-8-nitro-3,4-dihydro-2H-pyrimido[2,1-b][1,: Yield : 74%; Melting point

198-2003]benzothiazole-3-carboxylate(1c, C16H12N2OS)0C. IR (KBr, cm-1) : 3440 cm-1(OH), 2854 cm-1(CH), 2322 cm-1(NH), 1728 cm-1 (C=O), 1512 cm-1(-NO2), 1450 cm-1(C=N). 1H-NMR (DMSO- d6) δ ppm: 7.9-8.1(m, 4H, pyrimidine), 7.1-7.7(m, 8H, Ar-H), 6.7-6.9(m, 3H, CH), 6.5(S, 1H, OH), 2.2(d, 2H, CH3) MS (m/z): 401.36(M+) Anal. Calcd. For C19H18N3O5S (400.42): C 56.99, H 4.53, N 10.49. Found: (401.36) 56.85, H 4.77, N 10.47.

7.3. Synthesis of Ethyl 4-(4-hydroxyphenyl)-8-nitro-3,4-dihydro-2H-pyrimido[2,1-b][1,3]benzothiazole-3-carboxylate(1c, C16H12N2OS): Yield

Yield : 74%; Melting point : 198-2000C. IR (KBr, cm-1) : 3440 cm-1(OH), 2854 cm-1(CH), 2322 cm-1(NH), 1728 cm-1 (C=O), 1512 cm-1(-NO2), 1450 cm-1(C=N). 1H-NMR (DMSO- d6) δ ppm: 7.9-8.1(m, 4H, pyrimidine), 7.1-7.7(m, 8H, Ar-H), 6.7-6.9(m, 3H, CH), 6.5(S, 1H, OH), 2.2(d, 2H, CH3) MS (m/z): 401.36(M+) Anal. Calcd. For C19H18N3O5S (400.42): C 56.99, H 4.53, N 10.49. Found: (401.36) 56.85, H 4.77, N 10.47.

7.4. Synthesis of 2-[(Z)-(1,3-benzothiazol-2-ylimino)methyl]phenol(1d, C14H10N2OS)

Yield : 70%; Melting Point : 198-2000C. IR (KBr, cm-1): 3170 cm-1 (CH), 2067 cm-1 (NH), 1650 cm-1 (C=O),1407 cm-1 (C=N). 1HNMR (DMSO- d6) δ ppm: 7.0-7.5 (m, 5H, Ar-H), 7.6(t, 2H, CH). MS (m/z) : 250.12(M+). AnalCalcd. For C10H7N3OS2 (249.31): C 48.17, H 2.83, N 16.85. Found: (248.96) C 48.08, H 2.43, N 16.05.

8. Biological application of benzothiazole and it's derivatives

Heterocyclic frameworks hold promise for new chemotherapeutic programmers for drug discovery. They serve as the building blocks of natural biocomponents and are also found in synthetic medications. Heterocyclic compounds contain well-known crucial features such lipophilicity, polarity, and solubility that are required for drug discovery. One of the most significant classes of esteemed heterocycles, benzothiazoles are present in a variety of marine and terrestrial bioactive natural elements. Researchers are looking on making benzothiazole more effective as a cancer treatment or cure. There is extensive study being done for the development of new possible anticancer moieties because it is a severe health issue. In addition to being effective against cancer-causing cells, benzothiazole-2-thiol derivatives (2-((6-acetamidobenzo[d] thiazol-2-yl) thio) -N-ethyl acetamide) (1) have also demonstrated anti-proliferative activity on HepG2 and MCF-7 cell lines. a few recently synthesized amino) (phenyl-methyl) phosphonic acid) (2) were discovered to be active against cancer-After being produced in ionic media with high yield and phosphonates consisting of fluorine and discovered to be active causing cells [10].

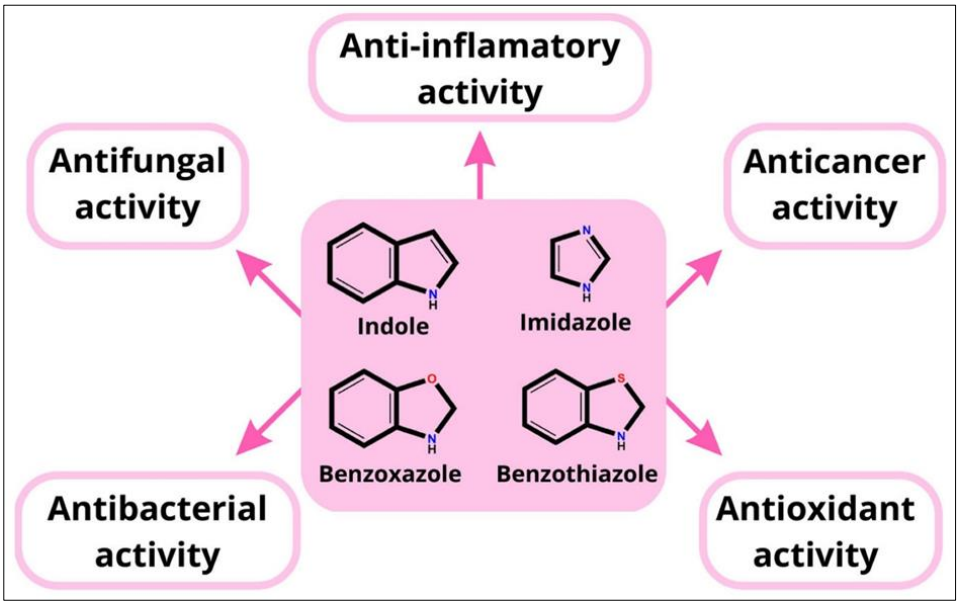


Figure 4 Biological application of benzothiazole and its derivatives

8.1. Anti-mycobacterial activity

Agar diffusion technique study of antibacterial activity: All recently synthesized compounds were tested *in vitro* for antibacterial activity against Escherichia coli (Gramme negative), and Staphylococcus aureus (Gram-positive), at doses of 75 g/ml and 100 g/ml, respectively, using the agar plate diffusion technique. The antibiotic Amoxicillin, at a concentration of 75 g/ml, demonstrated a zone of inhibition of 20 mm for Gram-negative organisms and a zone of inhibition of 22 mm for Gram-positive organisms under the same conditions.

8.2. Anti-tubercular activity

For the antimycobacterial assay, Microplate Alamar Blue Susceptibility Test (MABA) was utilized. It was done in 96-well black, clear-bottomed microplates (black view plates; Packard Instrument Company, Meriden, Conn.) to lessen background fluorescence. Sterile water was added to the perimeter wells on the outside to prevent dehydration of the experimental wells. Initial drug dilutions were performed in distilled deionized water or DMSO, and subsequent 2-fold dilutions in 0.1 ml of 7H9GC (without Tween 80) were completed in the microplates. BACTEC 12B passaged inoculate was initially diluted 1:2 in 7H9GC, and 0.1ml was applied to wells [11].

The development of novel compounds to deal with resistant bacteria and fungi has emerged as one of the most important fields of antibacterial and antifungal research today. This is because resistance of harmful bacteria and fungi to currently available antimicrobial medications is quickly emerging as a significant problem worldwide. Finding novel, potent antibacterial and antifungal is therefore becoming more and more challenging and demanding. Several 4H-pyrimido[2,1-b][1,3]benzothiazole derivatives were developed and tested for their efficacy against gram-positive and gram-negative bacteria, including Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella typhi, Escherichia coli, Bacillus cereus, and Providence rettegeri. As pharmacophore hybrids between pyrazolinone/pyrazole and benzothiazole moiety, Amir et al. created and evaluated a new class of 4-arylhydrazono-1-benzothiazolyl-3-methylpyrazolin-5-ones and 4-arylazo-1-benzothiazolyl-3,5-dimethylpyrazoles.

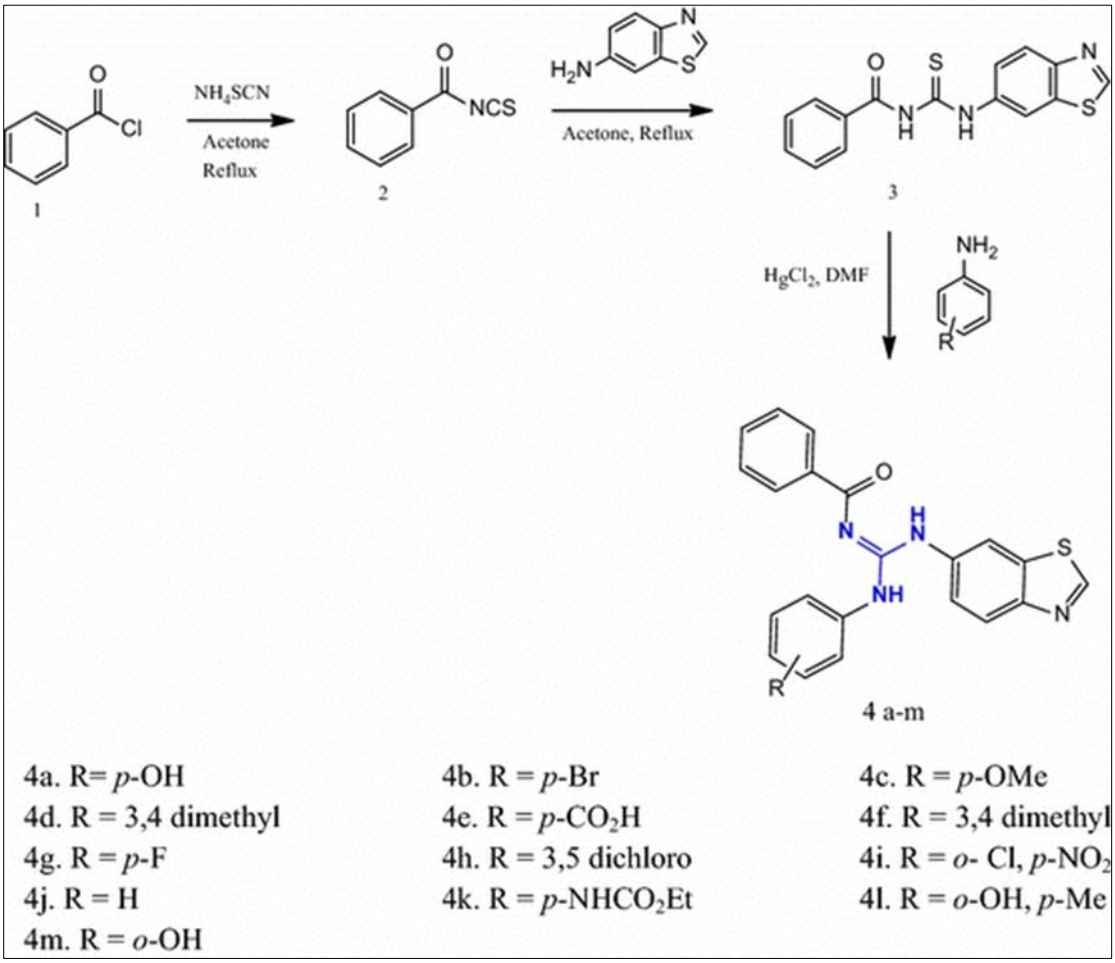


Figure 5 Synthesis of 4H-pyrimido[2,1-b][1,3]benzothiazole derivatives

9. *In vitro* evaluation of antimycobacterial activity

Determination of minimal inhibition concentrations: The Lowenstein-Jensen approach was used to screen test compounds using the Mycobacterium TB H37Rv strain (MTCC 200) of the synthesized medications' antitubercular potency was evaluated at the Gandhi-nagar Micro pharmacy Laboratory[12].

To make stock solutions with a concentration of 2000 g/mL, compounds (3 mg) were dissolved in 1.5 mL DMSO and diluted with DMSO. Two concentrations—50 and 25 g/mL—were acclimated in order to evaluate the antitubercular activity. A 0.5 mL aliquot of each concentration was placed into two distinct McCartney bottles. L.J. medium was then added and well mixed with 5 mL after that. The mixture was homogenized using a vortex mixer for one minute.

As necessary, sterile distilled water was added to adjust the opacity. At 85 °C for 40–45 minutes, 5 mL of medium in screw-capped tubes was in-spiced. This inspiration strategy was used three times. For comparing the antitubercular effects, isoniazid and rifampicin (3 mg) were used as the reference drugs. The drug disintegrated in As stated earlier,

DMSO was diluted and evaluated. The bottles were sterilized and solidified for three days at a temperature of 75 to 80 degrees.

9. Inoculation procedure

After diluting the standard suspension to 1 g/mL, 0.2 mL of the inoculums were applied to each tube to inoculate the culture. After inoculation, the tubes were incubated at 37°C in a tilted position with the screw cover just barely loose to allow the inoculum to evaporate. The bolt After 24-48 hours, the tubes underwent additional incubation before the caps were fastened. Following vaccination, observations were done on days 28 and 56. The proportion of bacilli was measured by comparing counts on drug-free (control) and drug-containing medium, and the results were interpreted based on counting the magnification at different angles [13].

10. Conclusion

The antimycobacterial effect was growing media dependent because only half of the compounds were active in the albumin-free medium while the majority of the derivatives were inactive in the proteinaceous medium. The mode of action of the active compounds was not determined and would require further study. The enzyme Glutamine Synthase-1, which is necessary for the survival and growth of MTB, was designed, docked, synthesized, and tested against a variety of benzothiazole Schiff bases. The results showed that the Minimum Inhibitory Concentration ranged from 100 to 6.25 g/ml. Other chemicals were found to be less active, however compound "d" was found to be just as responsive to traditional drugs (6.25 g/ml) as streptomycin. The creation, docking, synthesis, and assessment of many Satin derivatives of Schiff bases were created for The manufacture of benzothiazole is currently of interest due to its wide variety of biological properties, potent activities, and membership in a significant class of heterocyclic compounds. The Hofmann Method, Jacobson synthesis and oxidation by bromine, sulphuric acid benzyl trimethyl ammonium tribromide, copper, and palladium, chloroformamidium salt, Appel's salt to aid in the formation of the thiyl radical from the thiobenzamide, which cyclizes with loss of an atom of hydrogen, and Baker's yeast cyclization are some of the methods used to make benzothiazole. The Jacobson synthesis, one of the most popular Classical methods for the synthesis of benzothiazole, is based on the cyclization of thiobenzamides because each approach has advantages and disadvantages of its own.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have on conflict of interest.

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