Indian Journal of Advanced Chemistry (IJAC)
ISSN: 2582-8975 (Online), Volume-5 Issue-2, October 2025

Synthesis, Characterization, and Evaluation of the Antibacterial Activity of Some Novel Thiazolo-[1,2,4] Triazolo [1,5-a] Pyridine Derivatives

Pendam Prashanth Babu, Pingili Upendra, Dharanipathi Venkateshwar Rao

Abstract: ***A novel four-step scientific protocol has been reported for the synthesis of thiazolo- [1,2,4] triazolo[1,5-a] pyridine and its derivatives (6a-c) as target moieties in good overall yields by using 1-(2-(Trifluoromethyl)-5-methylthiazol-4-yl) ethanone (1) as starting compound. The IR, PMR, Mass spectral data, and elemental analysis validated the chemical structures of all the intermediates and products. Furthermore, the newly synthesised intermediates and final derivatives were screened for their antibacterial activity against different bacterial strains, and it was found that a few of them exhibited noteworthy antibacterial activity with varying degrees of disparity.***

Keywords: Thiazole, 1,2,4-Triazole, Pyridine Derivatives, Antibacterial Activity

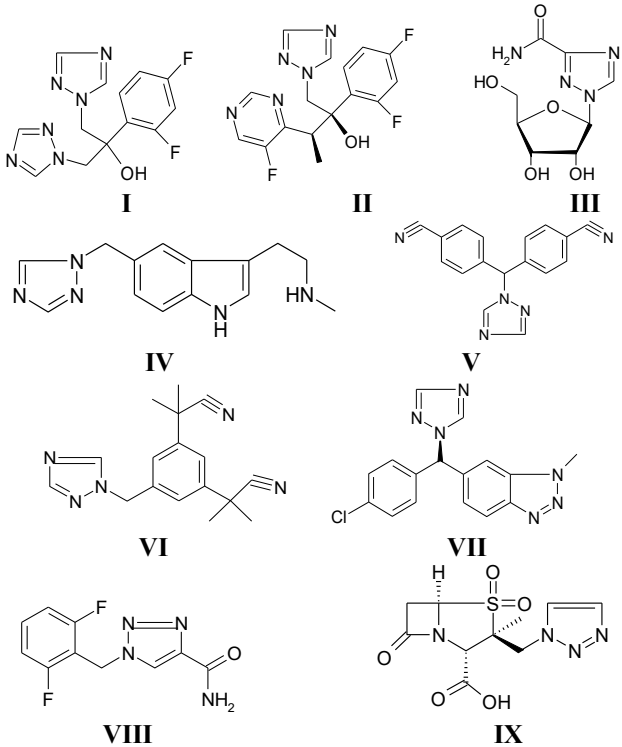
Abbreviations:
IR: Infrared
PMR: Proton Magnetic Resonance
NMR: Nuclear Magnetic Resonance
H: Hour
^{0}C: Degree Centigrade
MM: Millimetre
TLC: Thin Layer Chromatography
CM: Centimetre
FT: Fourier Transform
MHz: Mega Hertz
PPM: Parts Per Million
TMS: Tetra Methyl Silane
GC-MS: Gas Chromatography Mass Spectrometry
EI: Electron Ionization
CE: Capillary Electrophoresis
Mol: Mole
ML: Millilitre
MP: Melting Point
M/Z: Mass-To-Charge Ration

Manuscript received on 02 May 2025 | First Revised Manuscript received on 19 May 2025 | Second Revised Manuscript received on 16 September 2025 | Manuscript Accepted on 15 October 2025 | Manuscript published on 30 October 2025.

*Correspondence Author(s)
Dr. Pendam Prashanth Babu*, Professor, Department of Chemistry, Sree Chaitanya College of Engineering, Karimnagar, Hyderabad (Telangana), India. Email ID: prashanthchemistry987@gmail.com, ORCID ID: 0009-0000-5748-2256
Dr. Pingili Upendra, Assistant Professor, Department of Chemistry, Government Degree College for Women (Autonomous), Nalgonda, Hyderabad (Telangana), India. Email ID: upendra.pingili555@gmail.com
Dr. Dharanipathi Venkateshwar Rao, Assistant Professor, Department of Chemistry, Government Degree College, Ibrahimpatnam, Ranga Reddy, Hyderabad (Telangana), India. Email ID: dvraochem@gmail.com

I. INTRODUCTION

Heterocyclic chemistry is one of the most complex and intriguing branches of organic chemistry. Many broader aspects of this section are recognised as disciplines of general significance that impact nearly all aspects of modern organic, medicinal, and biological chemistry. The heterocyclic compounds constitute the most extensive and most varied family of organic compounds. These offer a high degree of structural diversity and have proven to be broadly and economically useful as therapeutic agents. They are widely found in natural products, including nucleic acids, plant alkaloids, anthocyanins, flavones, hem, chlorophyll, vitamins, proteins, and hormones. Synthetically produced heterocycles have enormous potential as the most promising molecules for lead structures in the design of various agrochemicals, pharmaceuticals, and veterinary products, and thus play a key role in human life.



The derivatives of the triazole ring have significant application value in various fields, including agrochemistry [1] and material chemistry [2]. Its unique structure facilitates the formation of a variety of enzymes and receptors, inducing broad-spectrum biological

activities, such as anticancer [3], antituberculosis [4], antibacterial [5], and anti-HIV [6]. Its derivatives have been widely applied in many medicinal scaffolds like, Fluconazole **(I)** [7], Voriconazole **(II)** [8], Ribavirin **(III)** [9], Rizatriptan **(IV)** [10], Letrozole **(V)** [11], Anastrozole **(VI)** [12], Vorozole **(VII)** [13], Rufinamide **(VIII)** [14], and Tazobactam **(IX)** [15]. On the other hand, Pyridine derivatives abundantly exist in nature, and they play a vital role in the field of heterocyclic chemistry [16]. Such compounds are widely used in various applications of medicinal science [17], and their derivatives have been synthesised and studied for their [18] biological and pharmacological significance [19]. Some of them proved to possess antiviral [20], anti-diabetic [21], antimicrobial [22], antitumor [23], antiparasitic [24], and neurotropic activities [25].

II. RESULTS AND DISCUSSION

With the increasing interest in triazole compounds as potential therapeutic agents and in continuation of our studies to design and construct some novel heterocycles with this core in the structure, herein we have been interested in reporting the synthesis of a few thiazole-based thiazolo-[1,2,4] triazolo [1,5-*a*] pyridine and its derivatives **(6a-c)**. The constitution of all the compounds has been identified by their spectral data (IR, PMR, and Mass) and elemental analysis. Finally, the antibacterial activity of compounds **(4-6)** was also evaluated against a few bacterial strains.

As per the synthetic sequence of the present investigation shown in Scheme 1, the reaction is initiated by the Aldol condensation of starting material, 1-(2-(Trifluoromethyl)-5-methylthiazol-4-yl)ethanone **(1)** with substituted benzald ehyde **(2a-c)** to produce the corresponding, (*E*)-3-(2-phenyl)-1-(2-(trifluoromethyl)-5-methylthiazol-4-yl)prop-2-en-1-one **(3a-c)** by using NaOH as a base in boiling ethanol for 8-10 h with steady stirring. The latter intermediate, 2-Amino-4-(phenyl)-6-(2(trifluoromethyl)-5-methylthiazol-4-yl) pyridine-3-carbonitrile (4a-c) has been prepared via cyclisation by refluxing the mixture of **3a-c** with malononitrile using ammonium acetate as a base in absolute ethanol under constant stirring for 6-7 h.

In the further conversion at refluxing temperature (140-150 ^{0}C) for 7-9 h, the intermediate **4a-c** with acetonitrile using $AlCl_3$ as a catalyst produced the corresponding *N*-(4-(2-phenyl)-3-cyano-6-(2-trifluoromethyl)-5-methylthiazol-4-yl) pyridine-2-yl) acetamide **(5a-c)** in good yields. To achieve the target derivatives, 7-(phenyl)-5-(2-(trifluoromethyl)-5-methylthiazol-4-yl)-2-methyl-[1,2,4]-triazolo[1,5-*a*] pyridine-8-carbonitrile **(6a-c)** through cyclisation, the final intermediate, **5a-c** is reacted with MnO_2 in benzene under reflux for 10-12 h and yield of the obtained products ranged within 74-79 %.

III. ANTIBACTERIAL ACTIVITY

The newly synthesized compounds **4a-c, 5a-c**, and **6a-c** have been evaluated *in vitro* for their antibacterial activity against various bacterial strains such as Pseudomonas aeruginosa, Bacillus subtilis, Salmonella paratyphi, Staphylococcus aureus, Shigella flexneri, and Escherichia coli by cup-plate method [26] and the zone of inhibition was determined in mm. The activity of the tested compounds was compared with that of the known antibacterial agent Ampicillin, and the results are disclosed in Table 1. According to the screening output, it is observed that derivatives 4a-c, 5a-c, and 6a-c exhibited low to good activity, with a degree of disparity. Products **6a** and **6c** disclosed the highest activity with a 27 mm zone of inhibition each, and compound 4a exhibited the lowest activity with 12 mm against P. aeruginosa. The evaluation of the antibacterial activity against *B. subtilis* revealed that the most active appeared to be derivative **6b**, with an inhibition of 21 mm, while **4c** had the least activity. Similarly, compound **6b** showed very high activity with a 24 mm zone of inhibition against *S. paratyphi*. The most active derivatives were **6b** against *S. aureus*, **6c** towards *S. flexneri*, and **6a** in the direction of *E. coli*, with zone of inhibition of 27 mm, 24 mm, and 28 mm, respectively. It is interesting to note that none of the compounds in the present investigation is inactive towards any bacterial strain.

IV. EXPERIMENTAL SECTION

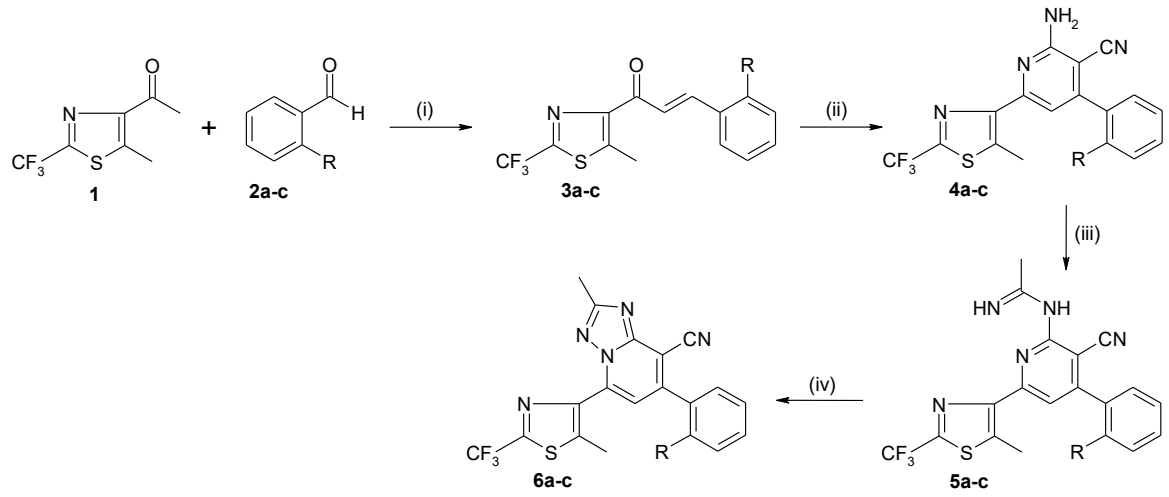
Melting points were determined with a B-540 Melting point Analyzer and are uncorrected. TLC was performed with Merck Silica gel 60 F254 silica gel plates. The IR spectra (ν cm^{-1}) were recorded on a Perkin Elmer Spectrum Bx FT-IR spectrometer using KBr tablet pellets. The ^{1}H NMR was recorded in $CDCl_3$ or DMSO-d_6 as a solvent on the Varian Gemini NMR spectrometer at 300 MHz. Chemical shifts were expressed as δ, ppm relative to TMS. Mass spectra were measured with a Shimadzu GC-MS-QP-1000 EX mass spectrometer in the EI (70 eV) mode. Elemental analyses have been executed with a CE-440 elemental analyser.

Preparation of (*E*)-3-(2-substituedphenyl)-1-(2-(trifluoro methyl)-5-methylthiazol-4-yl) prop-2-en-1-ones (3a-c)

A solution of 1-(2-(Trifluoromethyl)-5-methylthiazol-4-yl) ethanone **(1)** (0.01 mol) and substituted benzaldehyde **(2a-c)** (0.01 mol), sodium hydroxide solution (2%, 3 mL) in absolute ethanol (30 mL) was refluxed for 8-10 h. After completion of the reaction, the reaction mixture was poured onto ice-cold water (50 mL). The formed precipitate was filtered off, washed with water, and dried. Purification was carried out by dissolving in ethanol to give pure (*E*)-3-(2-substitutedphenyl)-1-(2-(trifluoromethyl)-5-methylthiazol-4-yl) prop-2-en-1-ones **(3a-c)**.

Preparation of 2-Amino-4-(2-substituedphenyl)-6-(2(trifluo romethyl)-5-methylthiazol-4-yl) pyridine-3-carbonitriles (4a-c)

A mixture of compound **3a-c** (0.01 mol), malonitrile (0.01 mol), and ammonium acetate (0.07 mol) was dissolved in absolute ethanol (20 mL). The resulting solution was refluxed on a water bath with uniform stirring for 6-7 h. After achieving the reaction,



Scheme 1: Preparation of Thiazolo- [1,2,4] Triazolo[1,5-*a*] Pyridines (6a-c)

Reagents and conditions: (i) Ethanol, NaOH, reflux, 8-10h; (ii) Malononitrile, CH_3COONH_4, ethanol, reflux, 6-7h; (iii) $AlCl_3$, acetonitrile, 140-*150 ^{0}C, 7-9h; (iv) MnO_2, benzene, reflux, 10-12h; 2-6 (a) R = Br, (b) R = NO_2, (c) R = OCH_3*

Table-I: Antibacterial Activity of Compounds 4a-c, 5a-c and 6a-c

Entry	P. auregenosa	B. subtilis	S. paratyphi	S. aureus	S. flexneri	E. coli
4a	12	10	13	14	11	12
4b	18	15	16	16	14	16
4c	16	09	10	17	10	14
5a	21	18	12	14	16	17
5b	22	16	17	20	21	21
5c	25	20	15	24	20	23
6a	27	17	20	21	23	28
6b	22	21	24	27	21	25
6c	27	20	18	25	24	27
Standard	30	24	26	33	30	33

The residue was dropped into ice-cold water, and neutralised with dilute HCl to yield the crude product, which later was recrystallised from ethanol to obtain pure 2-Amino-4-(2-substitutedphenyl)-6-(2(trifluoromethyl)-5-methylthiazol-4-yl) pyridine-3-carbonitriles **(4a-c)**.

Preparation of *N*-(4-(2-Substited phenyl)-3-cyano-6-(2-trifluoromethyl)-5-methylthiazol-4-yl) pyridine-2-yl) acetamides (5a-c)

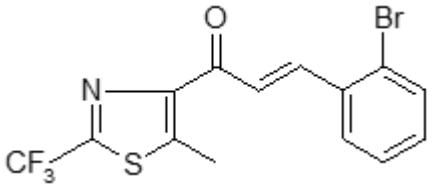
A mixture of compound **4a-c** (0.01 mol), dry $AlCl_3$ (0.02 mol), and acetonitrile (2 mL) was heated in an oil bath at 140-150 ^{0}C for 7-9 h with constant stirring. After fulfilment of the reaction, the residue was cooled and dropped in ice-cold water to precipitate the crude product which was later filtered off, washed with water, and crystallised from ethanol to offer *N*-(4-(2-Substited phenyl)-3-cyano-6-(2-trifluoromethyl)-5-methylthiazol-4-yl) pyridine-2-yl) acetamides **(5a-c)** in pure form.

Preparation of 7-(2-Substitutedphenyl)-5-(2-(trifluoro methyl)-5-methylthiazol-4-yl)-2-methyl-[1,2,4]-triazolo[1,5-*a*] pyridine-8-carbonitriles (6a-c) The solution of compound **5a-c** (0.01) and MnO_2 (0.01 mol) in benzene (25 mL) was heated at reflux temperature for 10-12 h.

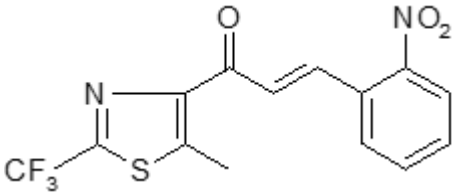
After the realisation of the reaction, the reaction mixture was filtered hot. Solvent was evaporated to collect crude product which was filtered, washed, and recrystallized from ethanol to offer pure 7-(2-Substitutedphenyl)-5-(2-(trifluoromethyl)-5-methylthiazol-4-yl)-2-methyl-[1,2,4]-triazolo[1,5-*a*] pyridine-8-carbonitriles **(6a-c)**.

V. PHYSICAL AND SPECTRAL DATA

(*E*)-3-(2-Bromophenyl)-1-(2-(trifluoromethyl)-5-methylthiazol-4-yl)prop-2-en-1-one (3a): Colour: Brown, Yield: 74%, Mp: 125-127 ^{0}C, IR (KBr, ν, cm^{-1}): 3045 (**C-H**, Ar), 2974 (**C-H**, CH_3), 1648 (**C=O**), 1625 (=**C-H**), 1584 (**C=C**, Ar), 1465 (**C=N**); PMR ($CDCl_3$, δ, ppm): 7.79-7.52 (m, 4H, **Ar-H**), 7.12 (d, 1H, J = 14.5 Hz, CO**CH**=), 6.48 (d, 1H, J = 14.5 Hz, Ar **CH**), 2.85 (s, 3H, **CH_3**); Mass (EI, m/z): 375; Elemental analysis: Calculated for $C_{14}H_9BrF_3NOS$: C-44.70, H-2.41, Br-21.24, F-15.15, N-3.72, O-4.25, S-8.52. Found: C-44.65, H-2.41, Br-21.22, F-15.13, N-3.72, O-4.25, S-8.52.

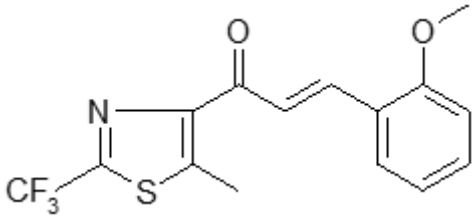


(*E*)-3-(2-Nitrophenyl)-1-(2-(trifluoromethyl)-5-methylthiazol-4-yl)prop-2-en-1-one (3b): Colour: Yellow, Yield: 79%, Mp: 114-116 ^{0}C, IR (KBr, ν, cm^{-1}): 3038 (**C-H**, Ar), 2969 (**C-H**, CH_3), 1645 (**C=O**), 1632 (=**C-H**), 1592 (**C=C**, Ar), 1472 (**C=N**); PMR (DMSO-d_6, δ, ppm): 7.72-7.49 (m, 4H, **Ar-H**), 7.21 (d, 1H, J = 15.2 Hz, CO**CH**=), 6.58 (d, 1H, J = 15.2 Hz, Ar**CH**=), 2.79 (s, 3H, **CH_3**); Mass (EI, m/z): 342; Elemental analysis: Calculated for $C_{14}H_9F_3N_2O_3S$: C-48.98, H-2.94, F-16.60, N-8.16, O-13.98, S-9.34. Found: C-48.84, H-2.94, F-16.58, N-8.16, O-13.96, S-9.33.

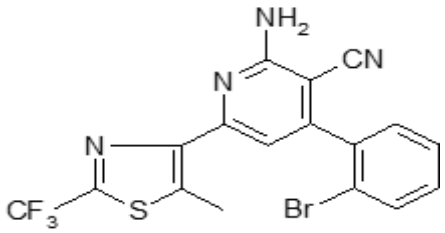


(*E*)-3-(2-Methoxyphenyl)-1-(2-(trifluoromethyl)-5-methylthiazol-4-yl)prop-2-en-1-one (3c): Colour: Pale yellow, Yield: 71%, Mp: 130-132 ^{0}C, IR (KBr, ν, cm^{-}

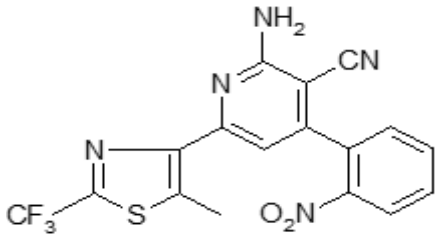
^{1}): 3044 (**C-H**, Ar), 2975 (**C-H**, CH_3), 1652 (**C=O**), 1640 (=**C-H**), 1588 (**C=C**, Ar), 1462 (**C=N**); PMR ($CDCl_3$, δ, ppm): 7.69-7.40 (m, 4H, **Ar-H**), 7.25 (d, 1H, J = 16.0 Hz, CO**CH**=), 6.51 (d, 1H, J = 16.0 Hz, Ar**CH**=), 3.25 (s, 3H, OCH_3), 2.81 (s, 3H, **CH_3**); Mass (EI, m/z): 327; Elemental analysis: Calculated for $C_{15}H_{12}F_3NO_2S$: C-55.04, H-3.70, F-17.41, N-4.28, O-9.78, S-9.80. Found: C-54.95, H-3.70, F-17.39, N-4.28, O-9.77, S-9.79.



2-Amino-4-(2-Bromophenyl)-6-(2(trifluoromethyl)-5-methylthiazol-4-yl)pyridine-3-carbonitrile (4a): Colour: Gray, Yield: 75%, Mp: 121-123 ^{0}C, IR (KBr, ν, cm^{-1}): 3235 (**N-H**, NH_2), 3062 (**C-H**, Ar), 2962 (**C-H**, CH_3), 2236 (C≡N), 1594 (**C=C**, Ar), 1455 (**C=N**); PMR (DMSO-*d*$_6$, δ, ppm): 8.35 (s, 2H, **NH_2**), 7.58-7.32 (m, 5H, **Ar-H**), 2.74 (s, 3H, **CH_3**); Mass (EI, m/z): 438; Elemental analysis: Calculated for $C_{17}H_{10}BrF_3N_4S$: C-46.48, H-2.29, Br-18.19, F-12.98, N-12.76, S-7.30. Found: C-46.45, H-2.29, Br-18.17, F-12.97, N-12.75, S-7.30.

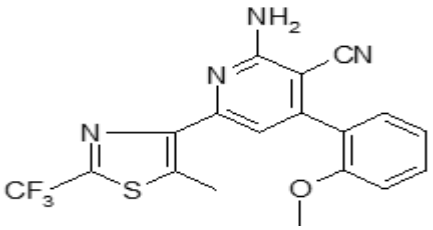


2-Amino-4-(2-Nitrophenyl)-6-(2(trifluoromethyl)-5-methylthiazol-4-yl)pyridine-3-carbonitrile (4b): Colour: Brown, Yield: 71%, Mp: 141-143 ^{0}C, IR (KBr, ν, cm^{-1}): 3241 (**N-H**, NH_2), 3055 (**C-H**, Ar), 2972 (**C-H**, CH_3), 2242 (C≡N), 1584 (**C=C**, Ar), 1464 (**C=N**); PMR ($CDCl_3$, δ, ppm): 8.31 (s, 2H, **NH_2**), 7.62-7.38 (m, 5H, **Ar-H**), 2.78 (s, 3H, CH_3); Mass (EI, m/z): 405; Elemental analysis: Calculated for $C_{17}H_{10}F_3N_5O_2S$: C-50.37, H-2.49, F-14.06, N-17.28, O-7.89, S-7.91. Found: C-50.32, H-2.49, F-14.05, N-17.26, O-7.89, S-7.91.

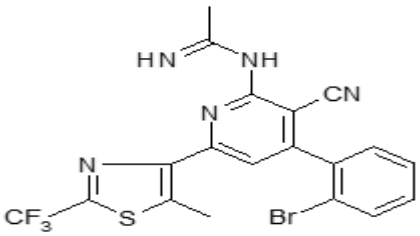


2-Amino-4-(2-Methoxyphenyl)-6-(2(trifluoromethyl)-5-methylthiazol-4-yl) pyridine-3-carbonitrile (4c): Colour: Light brown, Yield: 77%, Mp: 109-111

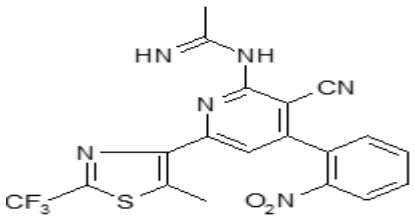
^{0}C, IR (KBr, ν, cm^{-1}): 3262 (**N-H**, NH_2), 3060 (**C-H**, Ar), 2977 (**C-H**, CH_3), 2252 (C≡N), 1578 (**C=C**, Ar), 1469 (**C=N**); PMR ($CDCl_3$, δ, ppm): 8.39 (s, 2H, **NH_2**), 7.68-7.42 (m, 5H, **Ar-H**), 3.19 (s, 3H, O**CH_3**), 2.80 (s, 3H, **CH_3**); Mass (EI, m/z): 390; Elemental analysis: Calculated for $C_{18}H_{13}F_3N_4OS$: C-55.38, H-3.36, F-14.60, N-14.35, O-4.10, S-8.21. Found: C-55.31, H-3.36, F-14.58, N-14.33, O-4.10, S-8.20.



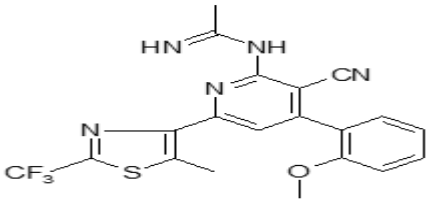
***N*-(4-(2-Bromophenyl)-3-cyano-6-(2-trifluoromethyl)-5-methylthiazol-4-yl)pyridine-2-yl)acetamide (5a):** Colour: Gray, Yield: 81%, Mp: 144-146 ^{0}C, IR (KBr, ν, cm^{-1}): 3254 (**N-H**, NH_2), 3051 (**C-H**, Ar), 2962 (**C-H**, CH_3), 2241 (C≡N), 1565 (**C=C**, Ar), 1478 (**C=N**); PMR (DMSO-*d*$_6$, δ, ppm): 7.71-7.49 (m, 5H, **Ar-H**), 7.21 (s, 1H, =**NH**), 4.52 (s, 1H, **NH**), 2.62 (s, 3H, **CH_3**), 2.48 (s, 3H, NH=C**CH_3**); Mass (EI, m/z): 479; Elemental analysis: Calculated for $C_{19}H_{13}BrF_3N_5S$: C-47.51, H-2.79, Br-16.64, F-11.87, N-14.58, S-6.68. Found: C-47.40, H-2.79, Br-16.62, F-11.85, N-14.56, S-6.68.



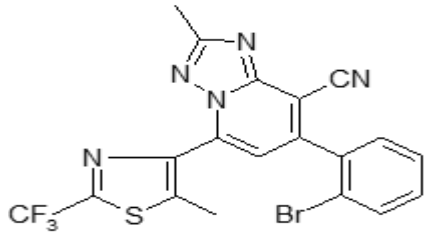
***N*-(4-(2-Nitrophenyl)-3-cyano-6-(2-trifluoromethyl)-5-methylthiazol-4-yl)pyridine-2-yl)acetamide (5b):** Colour: Ash, Yield: 85%, Mp: 139-141 ^{0}C, IR (KBr, ν, cm^{-1}): 3264 (**N-H**, NH_2), 3048 (**C-H**, Ar), 2958 (**C-H**, CH_3), 2260 (**C≡N**), 1574 (**C=C**, Ar), 1472 (**C=N**); PMR ($CDCl_3$, δ, ppm): 7.69-7.29 (m, 5H, **Ar-H**), 7.30 (s, 1H, =**NH**), 4.50 (s, 1H, **NH**), 2.67 (s, 3H, **CH_3**), 2.52 (s, 3H, NH=C**CH_3**); Mass (EI, m/z): 446; Elemental analysis: Calculated for $C_{19}H_{13}F_3N_6O_2S$: C-51.12, H-2.94, F-12.77, N-18.83, O-7.17, S-7.18. Found: C-51.01, H-2.94, F-12.76, N-18.81, O-7.17, S-7.18.



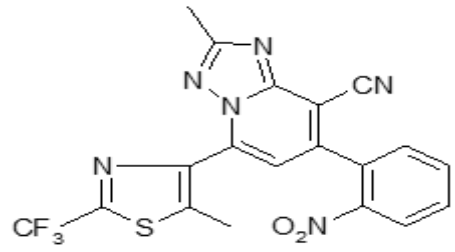
***N*-(4-(2-Methoxyphenyl)-3-cyano-6-(2-trifluoromethyl)-5-methylthiazol-4-yl)pyridine-2-yl)acetamide (5c):** Colour: Gray, Yield: 82%, Mp: 114-116 ^{0}C, IR (KBr, ν, cm^{-1}): 3248 (**N-H**, NH_2), 3067 (**C-H**, Ar), 2948 (**C-H**, CH_3), 2258 (C≡N), 1582 (**C=C**, Ar), 1463 (**C=N**); PMR ($CDCl_3$, δ, ppm): 7.65-7.34 (m, 5H, **Ar-H**), 7.35 (s, 1H, =**NH**), 4.54 (s, 1H, **NH**), 3.12 (s, 3H, OCH_3), 2.64 (s, 3H, **CH_3**), 2.49 (s, 3H, NH=C**CH_3**); Mass (EI, m/z): 431; Elemental analysis: Calculated for $C_{20}H_{16}F_3N_5OS$: C-55.68, H-3.74, F-13.21, N-16.23, O-3.71, S-7.43. Found: C-55.59, H-3.74, F-13.20, N-16.21, O-3.71, S-7.43.



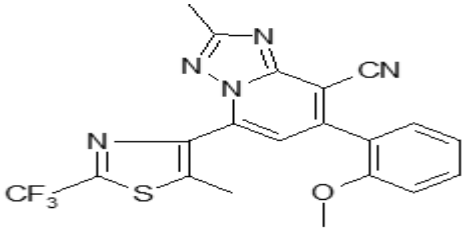
7-(2-Bromophenyl)-5-(2-(trifluoromethyl)-5-methylthiazol-4-yl)-2-methyl-[1,2,4]-triazolo[1,5-*a*]pyridine-8-carbonitrile (6a): Colour: Yellow, Yield: 74%, Mp: 120-122 ^{0}C, IR (KBr, ν, cm^{-1}): 3056 (**C-H**, Ar), 2968 (**C-H**, CH_3), 2242 (**C≡N**), 1574 (**C=C**, Ar), 1456 (**C=N**); PMR (DMSO-d_6, δ, ppm): 7.74-7.48 (m, 5H, **Ar-H**), 2.89 (s, 3H, **CH_3**), 2.52 (s, 3H, **CH_3**); Mass (EI, m/z): 477; Elemental analysis: Calculated for $C_{19}H_{11}BrF_3N_5S$: C-47.71, H- 2.32, Br-16.71, F-11.92, N-14.64, S-6.70. Found: C-47.65, H-2.32, Br-16.70, F-11.90, N-14.62, S-6.70.



7-(2-Nitrophenyl)-5-(2-(trifluoromethyl)-5-methylthiazol-4-yl)-2-methyl-[1,2,4]-triazolo[1,5-*a*]pyridine-8-carbonitrile (6b): Colour: Pale yellow, Yield: 79%, Mp: 108-110 ^{0}C, IR (KBr, ν, cm^{-1}): 3062 (**C-H**, Ar), 2971 (**C-H**, CH_3), 2252 (**C≡N**), 1579 (**C=C**, Ar), 1462 (**C=N**); PMR ($CDCl_3$, δ, ppm): 7.70-7.45 (m, 5H, **Ar-H**), 2.86 (s, 3H, **CH_3**), 2.50 (s, 3H, **CH_3**); Mass (EI, m/z): 444; Elemental analysis: Calculated for $C_{19}H_{11}F_3N_6O_2S$: C-51.35, H-2.49, F-12.83, N-18.91, S-7.22. Found: C-51.28, H-2.49, F-12.81, N-18.89, S-7.22



7-(2-Methoxyphenyl)-5-(2-(trifluoromethyl)-5-methylthiazol-4-yl)-2-methyl-[1,2,4]-triazolo[1,5-*a*]pyridine-8-carbonitrile (6c): Colour: Yellow, Yield: 78%, Mp: 118-120 ^{0}C, IR (KBr, ν, cm^{-1}): 3055 (**C-H**, Ar), 2977 (**C-H**, CH_3), 2259 (**C≡N**), 1565 (**C=C**, Ar), 1468 (**C=N**); PMR (DMSO-d_6, δ, ppm): 7.68-7.41 (m, 5H, **Ar-H**), 2.80 (s, 3H, **OCH_3**), 2.55 (s, 3H, **CH_3**), 2.59 (s, 3H, **CH_3**); Mass (EI, m/z): 429; Elemental analysis: Calculated for $C_{20}H_{14}F_3N_5OS$: C-55.94, H-3.29, F-13.27, N-16.31, O-3.73, S-7.47. Found: C-55.88, H-3.29, F-13.26, N-16.29, O-3.73, S-7.47.



VI. CONCLUSION

In conclusion, we have successfully synthesised a modern series of heterocyclic derivatives, such as thiazolo-[1,2,4]triazolo[1,5-a]pyridine and its derivatives (6a-c), as target moieties in good overall yields using readily available chemicals with a conventional and simple methodology. Eventually, the synthesised compounds were used to evaluate their pharmacological ability against some familiar bacterial strains, and we noticed that the prepared compounds exhibited moderate to good antibacterial activity.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.
- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. Musarurwa, H. & Tavengwa, N. T. (2021) Sustainable extraction of pesticides in food and environmental samples using emerging green adsorbents. Sustainable Chemistry and Pharmacy (CSP) (Vol. 24, Issue 12, Article number 100545). DOI: https://doi.org/10.1016/j.jfca.2019.103314
2. Rodrigues, L. D. Sunil, D. Chaithra, D. Bhagavath, P. (2020), 1,2,3/1,2,4-Triazole containing liquid crystalline materials: An up-to-date review of their synthetic design and mesomorphic behaviour, Journal of Molecular Liquids (JML) (Vol. 297, Issue 1, Article number 111909. DOI: https://doi.org/10.1016/j.molliq.2019.111909.
3. Sharma, A. Agrahari, A. K. Rajkhowa, S. Tiwari, V. K. (2022). Emerging impact of triazoles as anti-tubercular agent. European Journal of Medicinal Chemistry (EJMC) (Vol. 238, Issue-5, Article number 114454). DOI: https://doi.org/10.1016/j.ejmech.2022.114454
4. Zhang, S. Xu, Z. Gao, C. Ren, Q.C. Chang, L. Lv, Z.S. (2017). Triazole derivatives and their anti-tubercular activity. European Journal of Medicinal Chemistry (EJMC) (Vol. 138, Issue 29, pp. 501-513). DOI: https://doi.org/10.1016/j.ejmech.2017.06.051
5. Feng, Gao. Tengfei, W. Jiaqi, X. Gang, H. (2019). Antibacterial activity study of 1,2,4-triazole derivatives. European Journal of Medicinal Chemistry (EJMC) (Vol. 173, Issue 1, pp. 274-281) DOI: https://doi.org/10.1016/j.ejmech.2019.04.043
6. Li, Z. Cao, Y. Zhan, P. Pannecouque, C. Balzarini, J. De Clercq, E. Liu, X. (2013). Synthesis and anti-HIV evaluation of novel 1,2,4-triazole derivatives as potential non-nucleoside HIV-1 reverse transcriptase inhibitors. Letters in Drug Design & Discovery (LDDD) (Vol. 10, Issue 1, pp. 27-34). DOI: https://doi.org/10.2174/ 15701801380 4142429
7. Pinto, A. Chan, R. C. (2009). Lack of allergic cross-reactivity between fluconazole and voriconazole. Antimicrobial Agents and Chemotherapy (AAC) (Vol. 53, Issue-4, pp. 1715-1716). DOI: https://doi.org/:10.1128/ AAC.01500-08
8. Smith, J., Safdar, N., Knasinski, V., Simmons, W., Bhavnani, S. M., Ambrose, P. G. (2006). Voriconazole herapeutic drug monitoring. Antimicrobial

Agents and Chemotherapy (AAC) (Vol. 50, Issue-4, pp. 1570-1572). DOI: https://doi.org/10.1128/AAC.50.4.1570-1572.2006
9. Graci, J. D. Cameron, C. E. (2006). Mechanisms of action of ribavirin against distinct viruses. Reviews in Medical Virology (RMV) (Vol. 16, Issue 1, pp 37-48). DOI: https://doi.org/10.1002/rmv.483
10. Wellington, K., Plosker, G. L. (2002). Rizatriptan: an update of its use in the management of migraine. Drugs (Vol. 62, Issue-10, pp. 1539-1574) DOI: https://doi.org/10.2165/00003495-200262100-00007
11. Slomovitz, B. M. Filiaci, V. L. Walker, J. L. Taub, M.C. Finkelstein, K. A. Moroney, J. W. (2022). A randomized phase II trial of everolimus and letrozole or hormonal therapy in women with advanced, persistent or recurrent endometrial carcinoma: A GOG Foundation study. Gynecologic Oncology (GO). (Vol. 164, Issue-3, pp. 481-491). DOI: https://doi.org/10.1016/j.ygyno.2021.12.031.
12. Kucukguzel, S.G and Cikla-Suzgun, P. (2015). Recent advances in bioactive 1,2,4-triazole-3-thiones. European Journal of Medicinal Chemistry (EJMC) (Vol. 97, pp. 830-870). DOI: https://doi.org/10.1016/j.ejmech.2014.11.033
13. Takahashi, K. Yamagishi, G. Hiramatsu, T. Hosoya, A. Onoe, K. Doi, H. (2011). Practical synthesis of precursor of [*N-methyl*-^{11}C] vorozole, an efficient PET tracer targeting aromatase in the brain. Bioorganic Medicinal Chemistry (BMC). (Vol. 19, Issue- 4, pp. 1464-1470). DOI: https://doi.org/10.1016/j.bmc.2010.12.057
14. Striano, P., McMurray, R., Santamarina, E., Falip, M. (2018). Rufinamide for the treatment of Lennox-Gastaut syndrome: evidence from clinical trials and clinical practice. Epileptic Disorders (ED) (Vol. 20, Issue-1, pp. 13-29) DOI: https://doi.org/10.1684/epd. 2017.0950
15. Yang, Y. Rasmussen, B. A. Shlaes, D. M. (1999). Class A beta-lactamases--enzyme-inhibitor interactions and resistance. Pharmacology & Therapeutics (PT) (Vol. 83, Issue-2, pp. 141-151) DOI: https://doi.org/10.1016/S0163-7258(99)00027-3
16. Gomez, I. Alonso, E. Ramon, D. J. Yus, M. (2000). Naphthalene-catalysed Lithiation of Chlorinated Nitrogenated Aromatic Heterocycles and Reaction with Electrophiles. Tetrahedron (Vol. 56, Issue- 24, pp. 4043-4052). DOI: https://doi.org/10.1016/S0040-4020(00)00318-5
17. Altaf, A. A. Shahzad, A. Gul, Z. Rasool, N. Badshah, A. Lal, B. Khan, E. J. (2015). Synthesis, Crystal Structure, and DFT Calculations of 1,3-Diisobutyl Thiourea. Drug Design and Medicinal Chemistry (DDMC) (Vol. 1, 1, pp. 1-11) DOI: https://doi.org/10.1155/2015/913435
18. Man, X. Yongzhi, P. Li, Z. Shulin, W. Jiayou, J. Rakesh, K. P. (2019). Triazole derivatives as inhibitors of Alzheimer's disease: Current developments and structure-activity relationships. European Journal of Medicinal Chemistry (EJMC) (Vol. 180, Issue 15 pp. 656-672) DOI: https://doi.org/10.1016/j.ejmech.2019.07.059.
19. Litvinov, P. V. Dotsenko, V. V. Krivokolysko, S. G. Thienopyridines: synthesis, properties, and biological activity (2005). Russian Chemical Bulletin, International Edition (RCBIE) (Vol. 54, Issue- 4, pp. 864-904. DOI: https://doi.org/ 10665285/05/54040864/2005.
20. Schnute, M. E. Anderson, D. J. Brideau, R. J. (2007). 2-Aryl-2-hydroxyethylamine substituted 4-oxo-4,7-dihydrothieno- [2,3-b]pyridines as broad-spectrum inhibitors of human herpesvirus polymerases. Bioorganic & Medicinal Chemistry Letters (BMCL) (Vol. 17, Issue 12, pp. 3349-3353). DOI: https://doi.org/10.1016/j.bmcl.2007.03.102
21. Bahekar, R. H. Jain, M. R. Jadav, P.A. Prajapati, V.M. Patel, D.N. Gupta, A.A. Sharma, A. Tom, Andyopadhya, D. Modi, H. Patel, P. R. (2007). Design, synthesis, and biological evaluation of substituted-N-(thieno[2,3-b]pyridin-3-yl)-guanidines, N-(1H-pyrrolo[2,3-b]pyridin-3-yl)-guanidines, and N-(1H-indol-3-yl)-guanidines. Bioorganic & Medicinal Chemistry (BMC) (Vol. 15, Issue 9, pp. 3248-3265). DOI: https://doi.org/10.1016/j.bmc.2007.02.029
22. Abdel-Rahman, A. E. Bakhite, E. A. Al-Taifi, E. A. (2003). Synthesis and antimicrobial testing of some new S-substituted-thiopyridines, thienopyridines, pyridothienopyrimidines and pyridothienotriazines Pharmazie (Vol. 58, Issue 6, pp. 372-379). DOI: https://doi.org/10.1002/chin.200339135
23. Hayakawa, I. Shioya, R. Agatsuma, T. Furukawa, H. Sugano, Y. (2004). Thienopyridine and benzofuran derivatives as potent anti-tumour agents possessing different structure–activity relationships. Bioorganic & Medicinal Chemistry Letters (BMCL) (Vol. 14, Issue 13, pp. 3411-3415). DOI: https://doi.org/10.1016/j.bmcl.2004.04.079
24. Ichiro, H, Rieko, S., Toshinori, A., Hidehiko, F., Yuichi, S. (2004) Thienopyridine and benzofuran derivatives as potent anti-tumour agents possessing different structure-activity relationships, Bioorganic Medicinal Chemistry Letters (BMCL) (Vol. 14, Issue-13, pp. 3411-3414) DOI: https://doi.org/10.1016/j.bmcl.2004.04.079.
25. Krauze, A. Germame, S. Eberlins, O. Sturms, I. Klusa, V. Duburs, G. (1999). Derivatives of 3-cyano-6-phenyl-4-(3`-pyridyl)-pyridine-2(1H)-thione and their Neurotropic activity. European Journal of Medicinal Chemistry (EJMC) (Vol. 34, Issue-4, pp. 301-310). DOI: https://doi.org/10.1016/S0223-5234(99)80081-6.
26. Barry, A. I. (1976). The antimicrobial Susceptibility Test, Principles and Practices. 4th Ed. (ELBS), 1976, 80. https://books.google.co.in/books/about/The_Antimicrobic_Susceptibility_Test.html?id=LPNqAAAAMAAJ&redir_esc=y

AUTHOR'S PROFILE

Dr. Pendam Prashanth Babu is working as Professor for Chemistry in the Department of Humanities and Sciences in Sree Chaitanya College of Engineering, Karimnagar. He completed his Ph.D from Kakatiya University, Warangal, Telangana. His research focuses on the synthesis, characterisation and biocidal properties of organometallic complexes, heterocyclic compounds and copolymer and terpolymer resins.

Dr. Pingili Upendra is working as an Assistant **Professor** of Chemistry in the Department of Chemistry, Govt. Degree college for women (A), Nalgonda. He completed his Ph.D. at Kakatiya University, supported by a CSIR fellowship, at the Indian Institute of Chemical Technology (IICT), Hyderabad, Telangana. His research focuses on "Total synthesis of (-)- Varitriol, Obolactines, Myristict NEW Methodologies based on Th (II) complexes.

Dr. Dharanipathi Venkateshwar Rao is working as Assistant Professor of Chemistry in the Govt Degree College, Ibrahimpatnam. He completed his Ph.D from Osmania University, Hyderabad, Telangana. His research interests are photo degradation of pollutants and Dyes.