

# The 22nd International Electronic Conference on Synthetic Organic Chemistry

## Ultrasound-Assisted One Pot Synthesis of Novel 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole

### ▶ Presented By

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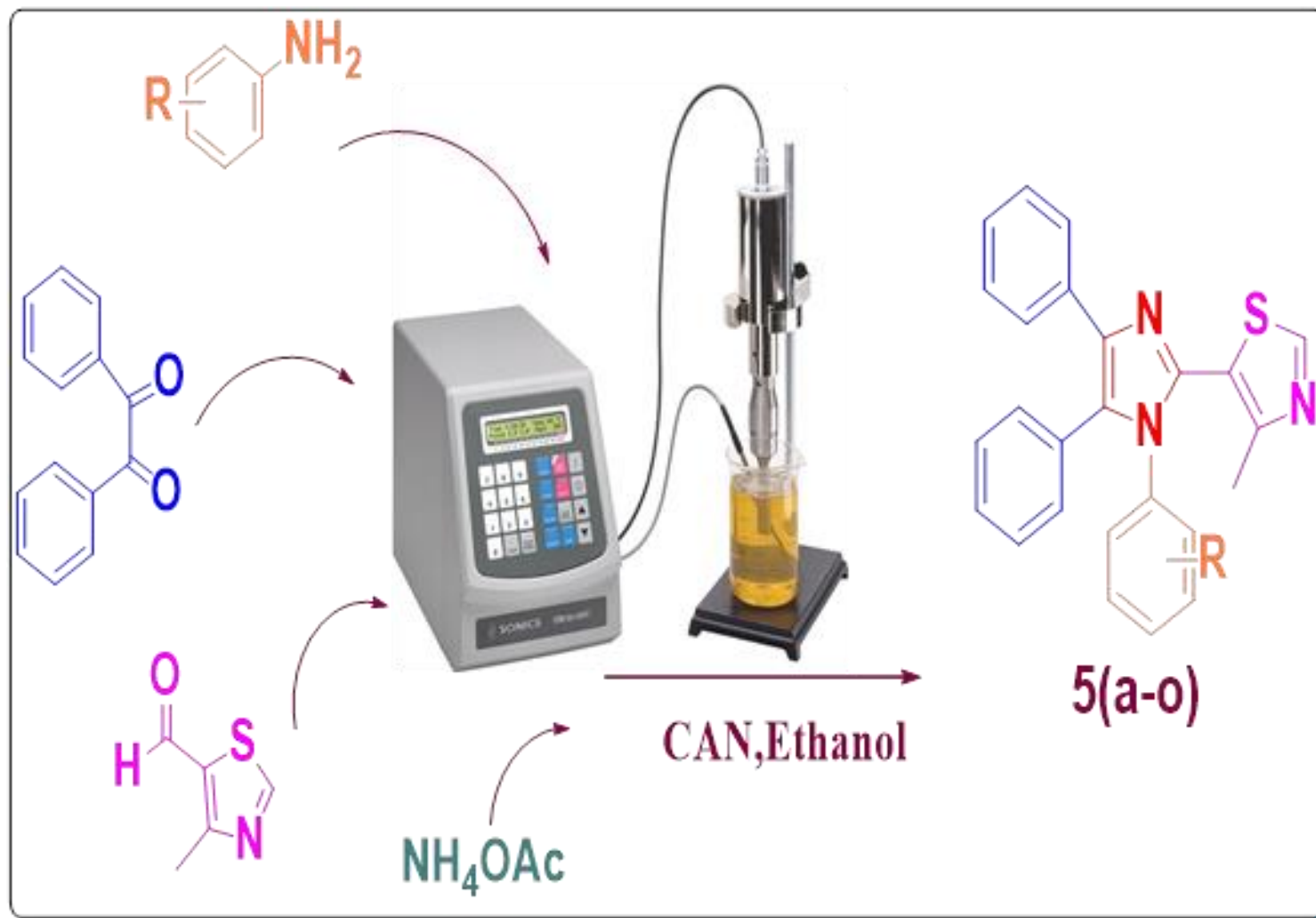
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## Graphical Abstract:



# Ultrasound-Assisted One Pot Synthesis of Novel 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole

## ▶ **Abstract:**

- ▶ The work reports synthesis of fifteen novel derivatives of 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole **5(a-o)**.
- ▶ The reaction of benzil, primary aryl amines, 4-methylthiazole-5-carbaldehyde, and ammonium acetate was carried out in one pot in presence of eco-friendly catalyst Ceric ammonium nitrate in solvent ethanol to give final compounds.
- ▶ The structures of the synthesized compounds were confirmed by spectral characterization such as IR, <sup>1</sup>H NMR, <sup>13</sup>CNMR and Mass spectral studies.

# Contents:

- ▶ Introduction
- ▶ Need of Study
- ▶ Objective of Study
- ▶ Scheme of synthesis
- ▶ Result & Discussion
- ▶ Materials and methods
- ▶ Experimental section
- ▶ Spectral characterization
- ▶ Conclusion
- ▶ Acknowledgment
- ▶ References

# Introduction

- ▶ Imidazole is a privileged fragment in modern medicinal chemistry considering its broad spectrum and affinity towards various biological targets specially as antifungal agent [1, 2].
- ▶ Synthesis of organic molecules through multicomponent reactions (MCRs) is a fascinating area of research [3-9], because they are significant basis of automated and high throughput synthesis, molecular diversity and empowering rapid generation of organic molecules. MCRs are distinct as reactions that materialize in one reaction vessel (one pot) having more than two starting reactants to form a single product [10-11]. MCRs in numerous occasions are effective alternative to multistep sequential synthesis for instance, they show high degree of atom efficiency as the maximum if not all of the atoms of the starting reactants are transformed in to the product [12-13]. They are convergent as a number of starting reactants combine in one step reaction to form the target molecules, they are having higher degree of efficiency since the product formation takes place in one-step in place of multiple sequential steps, bond formation between several atoms other than hydrogen atoms takes place in one synthetic step therefore they display extremely high bond-forming-index (BFI) [14-18].

- ▶ There is still a need of general awareness among synthetic chemists that MCRs are undeniably able to deal with delicate chemical problems in an environmentally friendly manner. This work thus aims to explore the scope and opportunities of utilization of MCRs that can bring for eco-friendly green synthesis and process design.
- ▶ The use of ultrasound to promote chemical reactions is called sono-chemistry. Ultrasonic-assisted organic synthesis (UAOS) is a green synthetic approach and it is a powerful technique towards the increase in reaction rate [19-21]. It can also be considered as important tool for conservation of energy and minimization of waste as compared to the conventional techniques [22-23].

## NEED OF STUDY

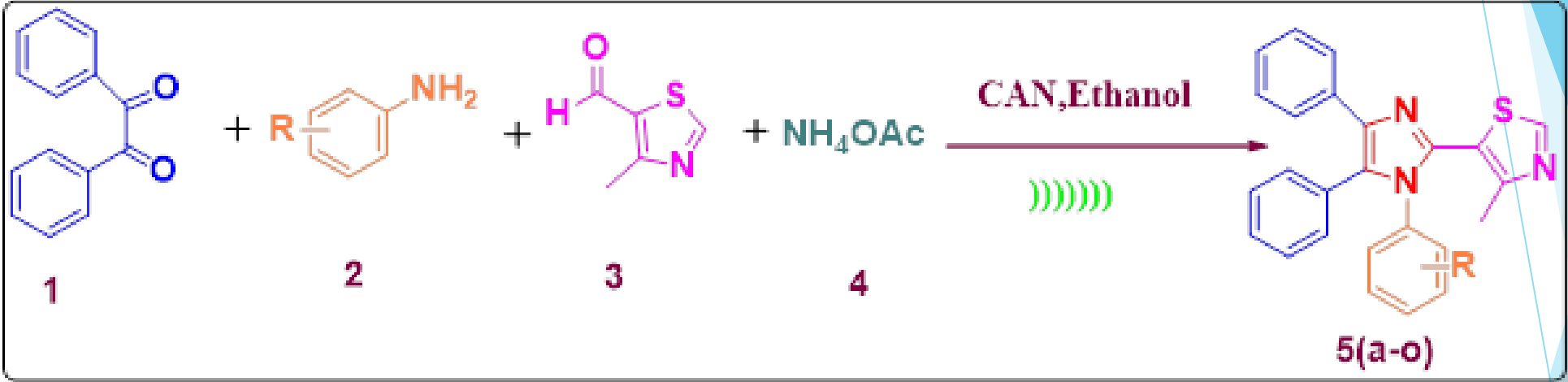
- ▶ The shortcomings associated with existing methods of organic synthesis reported for the imidazole derivatives by a conventional method like stirring at room temperature and by refluxing required several hours for completion of reaction with very less amount of product yield and consumes more solvents, time and electricity.
- ▶ The combination of two pharmacophores into a single molecule is an effective and commonly used direction in modern medicinal chemistry for the exploration of novel and highly active compounds.

## OBJECTIVE OF STUDY

- ▶ To design and synthesize novel hybrid heterocyclic compounds i.e. imidazole coupled with thiazole group as an appropriate pharmacophore.
- ▶ To use green chemistry tool for reaction i.e. ultrasound promoted synthesis.
- ▶ To confirm structures of the synthesized intermediates and final derivatives by chemical and spectral studies such as IR, Mass,  $^1\text{H}$ NMR,  $^{13}\text{C}$ NMR and elemental analysis.



# SCHEME OF SYNTHESIS



# Results and discussion

## ▶ Chemistry

- ▶ Herein, we are reporting the synthesis 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole **5(a-o)** as illustrated in **Scheme 1**.
- ▶ A mixture of benzil (0.01 mol), 4-methylthiazole-5-carbaldehyde (0.01 mol), primary aryl amines (0.01 mol), ammonium acetate (0.01 mol) and Cerriic ammonium nitrate (15 mol %) as an eco-friendly catalyst was dissolved in solvent ethanol (5 ml) was subjected to ultra-sonication at room temperature. The obtained products **5(a-j)** were recrystallized from ethanol and were obtained in better yields. Synthesis by a conventional method like refluxing required 3-4 hrs for completion of reaction; whereas by using green chemistry tool like ultra-sonication the time of synthesis was reduced to 25 to 35 minutes. The physical characterisation is as shown in **Table1**.

# Physical characterization of 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5(a-o)

Compound	Ar	Mol. Formula	Mol. weight	% Yield	M.P (°C)
5a	Phenyl	C <sub>25</sub> H <sub>19</sub> N <sub>3</sub> S	393.50	88	202-204
5b	4-Chlorophenyl	C <sub>25</sub> H <sub>18</sub> ClN <sub>3</sub> S	427.95	89	252-254
5c	4-Bromophenyl	C <sub>25</sub> H <sub>18</sub> BrN <sub>3</sub> S	472.40	90	254-256
5d	4-Nitrophenyl	C <sub>25</sub> H <sub>18</sub> N <sub>4</sub> O <sub>2</sub> S	438.50	89	225-228
5e	2-Methylphenyl	C <sub>26</sub> H <sub>21</sub> N <sub>3</sub> S	407.53	87	214-216
5f	4-Methylphenyl	C <sub>26</sub> H <sub>21</sub> N <sub>3</sub> S	407.53	88	210-212
5g	2-Methoxyphenyl	C <sub>26</sub> H <sub>21</sub> N <sub>3</sub> OS	423.53	89	228-230
5h	4-Methoxyphenyl	C <sub>26</sub> H <sub>21</sub> N <sub>3</sub> OS	423.53	89	232-234
5i	2,4 -Dichlorophenyl	C <sub>25</sub> H <sub>17</sub> Cl <sub>2</sub> N <sub>3</sub> S	462.39	89	256-258
5j	2,4-Dimethylphenyl	C <sub>27</sub> H <sub>23</sub> N <sub>3</sub> S	421.56	90	200-202
5k	2,4-Dinitrophenyl	C <sub>25</sub> H <sub>17</sub> N <sub>5</sub> O <sub>4</sub> S	483.50	87	218-220
5l	4-Chloro-2-nitrophenyl	C <sub>25</sub> H <sub>17</sub> ClN <sub>4</sub> O <sub>2</sub> S	472.95	86	232-234
5m	2,6-Dichloro-4-nitrophenyl	C <sub>25</sub> H <sub>16</sub> Cl <sub>2</sub> N <sub>4</sub> O <sub>2</sub> S	507.39	88	234-236
5n	Benzyl	C <sub>26</sub> H <sub>21</sub> N <sub>3</sub> S	407.53	90	220-222
5o	Naphthalen-1-yl	C <sub>29</sub> H <sub>21</sub> N <sub>3</sub> S	443.56	87	210-212

► The synthesis of all derivatives of 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole **5(a-o)** was carried out by refluxing and ultrasonic irradiation methods for comparison of conventional and modern green chemistry tool using ultra-sonication. The time required for completion of reaction with yield in percent is mentioned in **Table 2**.

► **Table 2.** Comparison of reaction kinetics of conventional refluxing and ultrasonic irradiation methods for the synthesized compounds **5(a-o)**.

Entry	Conventional Refluxing		Ultrasonic Irradiation	
	Time(min)	Yield(%)	Time(min)	Yield(%)
5a	240.00	72	30	88
5b	180.00	62	25	89
5c	230.00	74	25	90
5d	240.00	71	30	89
5e	230.00	73	30	87
5f	200.00	65	30	88
5g	230.00	67	35	89
5h	190.00	68	35	89
5i	220.00	66	30	89
5j	240.00	69	25	90
5k	240.00	71	35	87
5l	195.00	77	35	86
5m	200.00	78	35	88
5n	225.00	69	30	90
5o	235.00	65	35	87

## MATERIALS AND METHODS:

- ▶ All the reactions were performed in oven-dried glass wares. All the chemicals used for synthesis were procured from Merck (Mumbai, Maharashtra, India), Sigma (Mumbai), HiMedia (Mumbai) or Qualigens (Mumbai) and used without further purification. The ultrasound sonicator (Sonics Vibra-cell, Model no. VCX 500, Newtown, CT, USA) equipped with solid synthetic probe, 13 mm in tip diameter, operating at 20 kHz with a maximum power output of 500 W, was used for synthesis of final title compounds. The progress of each reaction was monitored by ascending thin layer chromatography (TLC) using pre-coated silica gel F254 aluminum TLC sheets (Merck) and the spots were visualized by UV light and iodine vapors. Elemental analyses (C, H, and N) was done with a FLASH EA 112 Shimadzu' analyzer (Mumbai) and all analyses were consistent (within 0.4%) with theoretical values. Infrared (IR) spectra were recorded on a PS 4000 FTIR (JASCO, Tokyo, Japan) using KBr pellets.  $^1\text{H}$  and  $^{13}\text{C}$ -NMR spectra were recorded on a Avance 400 spectrometer (Bruker, Billerica, MA, USA) fitted with an Aspect 3000 computer and all the chemical shifts (ppm) were referred to internal TMS for  $^1\text{H}$  and DMSO-*d*<sub>6</sub> for  $^{13}\text{C}$ -NMR.  $^1\text{H}$ -NMR data are reported in the order of chemical shift, multiplicity (s, singlet; d, doublet; t, triplet; q, quartet; br, broad; br s, broad singlet; m, multiplet and/or multiple resonance), number of protons. A Micro TOF-Q-II (Bruker Daltonics, Billerica, MA, USA) with electron spray ionization (ESI) was used to obtain the HRMS data.

## EXPERIMENTAL WORK

- ▶ a) **General procedure for the synthesis of 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5(a-o):** In a borosil beaker, a mixture of benzil (0.01 mol), 4-methylthiazole-5-carbaldehyde (0.01 mol), primary aryl amines (0.01 mol), ammonium acetate (0.01 mol) and ceric ammonium nitrate (15 mol %) as an eco-friendly catalyst was dissolved in solvent ethanol (5 ml) and the beaker was kept in acoustic chamber, the solid probe of ultrasound was lowered down in the beaker so as to immersed in the solvent and subjected to ultra-sonication at room temperature for 25 to 35 min. The completion of reaction was monitored by TLC. After completion of reaction, the mixture poured into ice-water mixture. The solid precipitate product was filtered dried. The crude product was purified by recrystallization from ethanol. Solvent system chosen determination was n-hexane: ethyl acetate (4:1). The products were obtained in good yield (88 % 92 %). The physical characterization data of the synthesized compounds 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole **5(a-o)** is as shown in **Table 1**.

# Spectral Characterization:

- ▶ *4-Methyl-5-(1,4,5-triphenyl-1H-imidazol-2-yl) thiazole 5a*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3155 CH stretching, 1601 C=C stretching, 1580 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.12 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.51-7.85 (m, 5H, 5H, 5H of aromatic rings), 8.99 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 12.6, 114.5, 122.4(2), 127.6(4), 128.9(4), 129.1(4), 129.8(2), 131.5, 133.9, 138.3(2), 142.6, 150.7 and 152.4; MS (ESI) m/z: 395.13 [M+2]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>19</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, N, S) 76.31, 4.87, 10.68, 8.15. Found: 75.69, 5.01, 11.23, 9.75.
- ▶ *5-(1-(4-Chlorophenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5b*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3150 CH stretching, 1600 C=C stretching, 1580 C=N stretching, 699 C-Cl stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.10 (s, 3H, -CH<sub>3</sub> of thiazole ring), 6.65-8.10 (m, 4H, 5H, 5H of aromatic rings), 8.85 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 11.93, 111.63, 125.31(2), 127.81(4), 128.5, 128.12, 128.71, 129.18, 129.65, 129.74, 129.87, 130.93(2), 131.43, 133.28(2), 136.34, 138.90(2), 145.55, and 161.36; MS (ESI) m/z: 431.72 [M+4]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>18</sub>ClN<sub>3</sub>S; Elemental Analysis: Calculated (C, H, Cl, N, S) 70.16, 4.24, 8.28, 9.82, 7.49. Found: 71.21, 5.47, 7.98, 10.01, 8.12.
- ▶ *5-(1-(4-Bromophenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5c*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3100 CH stretching, 1607 C=C stretching, 1580 C=N stretching, 680 C-Br stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.15 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.52-7.84 (m, 4H, 5H, 5H of aromatic rings), 8.94 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.2, 115.2, 122.1, 125.2(2), 127.3(4), 128.5(3), 129.1(4), 130.7, 132.9(2), 133.2, 137.4, 139.2, 143.5, 151.7 and 152.5; MS (ESI) m/z: 476.04 [M+4]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>18</sub>BrN<sub>3</sub>S; Elemental Analysis: Calculated (C, H, Br, N, S) 63.56, 3.84, 16.91, 8.90, 6.79. Found: 62.93, 3.55, 17.44, 9.14, 7.78.

- ▶ *4-Methyl-5-(1-(4-nitrophenyl)-4,5-diphenyl-1H-imidazol-2-yl) thiazole 5d*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3102 CH stretching, 1605 C=C stretching, 1581 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*6),  $\delta$  ppm: 2.99 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.55-8.68 (m, 4H, 5H, 5H of aromatic rings), 8.98 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*6),  $\delta$  ppm: 12.9, 113.8, 121.9(2), 123.5(2), 126.7(4), 127.9(2), 128.8(4), 130.5, 133.4, 138.6(2), 142.8, 145.2, 147.7, 149.9 and 153.1; MS (ESI) *m/z*: 440.12 [M+2]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>18</sub>N<sub>4</sub>O<sub>2</sub>S; Elemental Analysis: Calculated (C, H, N, S) 68.48, 4.14, 12.78, 7.31. Found: 69.17, 5.52, 13.44, 8.75.
- ▶ *5-(4,5-Diphenyl-1-o-tolyl-1H-imidazol-2-yl)-4-methylthiazole 5e*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3100 CH stretching, 1602 C=C stretching, 1580 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*6),  $\delta$  ppm: 2.03 (s, 3H, -CH<sub>3</sub> of aromatic ring), 2.98 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.53-7.87 (m, 4H, 5H, 5H of aromatic rings), 8.93 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*6),  $\delta$  ppm: 13.2, 17.5, 113.7, 121.0, 125.6(2), 126.7(4), 127.9(2), 130.2(4), 131.8, 132.7(2), 134.0, 138.8, 139.2, 139.7, 143.3, 151.1 and 153.6; MS (ESI) *m/z*: 409.15 [M+2]<sup>+</sup>; Molecular Formula: C<sub>26</sub>H<sub>21</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, N, S) 76.63, 5.19, 10.31, 7.87. Found: 77.32, 6.45, 11.24, 8.12.
- ▶ *5-(4,5-Diphenyl-1-p-tolyl-1H-imidazol-2-yl)-4-methylthiazole 5f*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3100 CH stretching, 1604 C=C stretching, 1581 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*6),  $\delta$  ppm: 2.54 (s, 3H, -CH<sub>3</sub> of aromatic ring), 2.88 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.56-7.89 (m, 4H, 5H, 5H of aromatic rings), 8.87 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*6),  $\delta$  ppm: 13.4, 22.3, 115.1, 124.5(2), 126.9(4), 128.3(2), 129.6(4), 130.4(2), 131.7, 134.2, 136.3, 137.4, 138.5(2), 143.6, 151.8 and 153.2; MS (ESI) *m/z*: 409.15 [M+2]<sup>+</sup>; Molecular Formula: C<sub>26</sub>H<sub>21</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, N, S) 76.63, 5.19, 10.31, 7.87. Found: 77.24, 6.02, 11.14, 8.36.
- ▶ *5-(1-(2-Methoxyphenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5g*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3101 CH stretching, 1600 C=C stretching, 1565 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*6),  $\delta$  ppm: 3.07 (s, 3H, -CH<sub>3</sub> of thiazole ring), 4.11 (s, 3H, -OCH<sub>3</sub>), 7.53-7.80 (m, 4H, 5H, 5H of aromatic rings), 8.88 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*6),  $\delta$  ppm: 13.5, 56.8, 113.5, 115.9, 118.7, 122.9, 125.7, 128.5(4), 128.9(2), 129.5(5), 131.2, 133.8, 138.4(2), 143.2, 151.6, 153.2 and 158.1; MS (ESI) *m/z*: 425.14 [M+2]<sup>+</sup>; Molecular Formula: C<sub>26</sub>H<sub>21</sub>N<sub>3</sub>OS; Elemental Analysis: Calculated (C, H, N, S) 73.73, 5.00, 9.92, 7.57. Found: 74.55, 6.12, 10.22, 8.14.



- ▶ *5-(1-(4-Methoxyphenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5h*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3107 CH stretching, 1605 C=C stretching, 1580 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 2.95 (s, 3H, -CH<sub>3</sub> of thiazole ring), 3.68 (s, 3H, -OCH<sub>3</sub>), 6.64-7.94 (m, 4H, 5H, 5H of aromatic rings), 7.95 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.33, 55.39, 111.63, 114.33(2), 125.33(2), 126.60(2), 128.07, 128.12, 128.71, 129.18, 129.65, 129.74, 129.87, 130.93(4), 131.43(2), 136.34, 145.55, 161.15 and 161.36; MS (ESI) *m/z*: 425.72 [M+2]<sup>+</sup>; Molecular Formula: C<sub>26</sub>H<sub>21</sub>N<sub>3</sub>OS; Elemental Analysis: Calculated (C, H, N, S) 73.73, 5.00, 9.92, 7.57. Found: 74.85, 6.14, 10.34, 8.12.
- ▶ *5-(1-(2,4-Dichlorophenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5i*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3158 CH stretching, 1606 C=C stretching, 1587 C=N stretching, 701 C-Cl stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.19 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.45-7.81 (m, 3H, 5H, 5H of aromatic rings), 8.91 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.8, 113.4, 15.2, 126.8(4), 127.5, 128.9(2), 129.7(4), 131.5, 132.1, 134.6, 136.2(2), 138.1(2), 139.2, 141.5, 151.4 and 153.7; MS (ESI) *m/z*: 468.05 [M+6]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>17</sub>Cl<sub>2</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, Cl, N, S) 64.94, 3.71, 15.33, 9.09, 6.93. Found: 65.11, 4.58, 16.47, 10.25, 7.12.
- ▶ *5-(1-(2,4-Dimethylphenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5j*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3161 CH stretching, 1612 C=C stretching, 1589 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 1.99 (s, 3H, -CH<sub>3</sub> of Ar. ring), 2.54 (s, 3H, -CH<sub>3</sub> of Ar. ring), 3.11 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.58-7.87 (m, 3H, 5H, 5H of aromatic rings), 8.87 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 11.9, 20.6, 23.8, 115.1, 126.7(4), 128.2(2), 129.8(4), 131.2, 132.4(2), 133.3, 134.9, 136.2, 138.3(2), 139.4, 143.5, 144.1, 151.9 and 153.5; MS (ESI) *m/z*: 423.16 [M+2]<sup>+</sup>; Molecular Formula: C<sub>27</sub>H<sub>23</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, N, S) 76.93, 5.50, 9.97, 7.61. Found: 77.14, 6.98, 10.54, 8.57.
- ▶ *5-(1-(2,4-Dinitrophenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5k*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3112 CH stretching, 1614 C=C stretching, 1592 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.07 (s, 3H, -CH<sub>3</sub> of thiazole ring), 7.58-8.99 (m, 3H, 5H, 5H of aromatic rings), 9.08 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.4, 113.7, 121.2, 126.8(4), 128.7(2), 130.1(4), 130.8, 131.5(2), 133.7(2), 138.6(2), 142.9, 145.2, 149.3, 151.9 and 153.4; MS (ESI) *m/z*: 485.10 [M+2]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>17</sub>N<sub>5</sub>O<sub>4</sub>S; Elemental Analysis: Calculated (C, H, N, S) 62.10, 3.54, 14.48, 6.63. Found: 63.02, 4.21, 15.18, 7.98.

- ▶ *5-(1-(4-Chloro-2-nitrophenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5l*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3145 CH stretching, 1609 C=C stretching, 1586 C=N stretching, 705 C–Cl stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 2.95 (s, 3H, –CH<sub>3</sub> of thiazole ring), 7.51-8.68 (3H, 5H, 5H of aromatic rings), 8.89 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 12.9, 114.5, 123.6, 125.7(2), 126.5(4), 127.9(2), 128.7(4), 130.4, 134.2(2), 135.6, 138.4(2), 141.6, 143.5, 151.8 and 153.1; MS (ESI) *m/z*: 476.07 [M+4]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>17</sub>ClN<sub>4</sub>O<sub>2</sub>S; Elemental Analysis: Calculated (C, H, Cl, N, S) 63.49, 3.62, 7.50, 11.85, 6.78. Found: 64.57, 4.45, 8.71, 12.44, 7.54.
- ▶ *5-(1-(2,6-Dichloro-4-nitrophenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5m*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3156 CH stretching, 1604 C=C stretching, 1585 C=N stretching, 698 C–Cl stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.11 (s, 3H, –CH<sub>3</sub> of thiazole ring), 7.37-8.19 (m, 2H, 5H, 5H of aromatic rings), 8.95 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.1, 115.4, 124.3(2), 128.2(4), 129.4(2), 130.1(4), 132.8, 134.5, 138.2(2), 138.6(2), 141.5, 143.8, 148.4, 151.7 and 153.9; MS (ESI) *m/z*: 513.04 [M+6]<sup>+</sup>; Molecular Formula: C<sub>25</sub>H<sub>16</sub>Cl<sub>2</sub>N<sub>4</sub>O<sub>2</sub>S; Elemental Analysis: Calculated (C, H, Cl, N, S) 59.18, 3.18, 13.97, 11.04, 6.32. Found: 60.11, 4.54, 14.21, 12.75, 7.30.
- ▶ *5-(1-Benzyl-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole 5n*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3158 CH stretching, 1607 C=C stretching, 1587 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.04 (s, 3H, –CH<sub>3</sub> of thiazole ring), 5.87 (s, 2H, –CH<sub>2</sub> of benzyl ring), 7.52-7.83 (m, 5H, 5H, 5H of aromatic rings), 8.99 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.5, 48.2, 115.4, 125.3, 127.1(4), 127.8(2), 128.5(4), 129.7(4), 130.2, 133.3, 138.4, 139.2, 142.3, 145.9, 151.4 and 153.7; MS (ESI) *m/z*: 408.15 [M+2]<sup>+</sup>; Molecular Formula: C<sub>26</sub>H<sub>21</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, N, S) 76.63, 5.19, 10.31, 7.87. Found: 77.24, 6.35, 11.23, 8.28.
- ▶ *4-Methyl-5-(1-(naphthalen-1-yl)-4,5-diphenyl-1H-imidazol-2-yl) thiazole 5o*: IR (KBr)  $\nu_{\max}$  (cm<sup>-1</sup>): 3151 CH stretching, 1609 C=C stretching, 1588 C=N stretching; <sup>1</sup>H-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 3.02 (s, 3H, –CH<sub>3</sub> of thiazole ring), 7.58-8.15 (m, 5H, 5H, 7H of aromatic rings), 8.89 (s, 1H of thiazole ring); <sup>13</sup>C-NMR(DMSO-*d*<sub>6</sub>),  $\delta$  ppm: 13.6, 115.3, 124.8, 126.1(2), 126.5, 127.3, 127.5(3), 127.9(2), 128.5(4), 129.6(4), 130.3, 131.2, 133.4, 135.6, 138.1, 138.9, 143.2, 151.6 and 153.4; MS (ESI) *m/z*: 444.15 [M+2]<sup>+</sup>; Molecular Formula: C<sub>29</sub>H<sub>21</sub>N<sub>3</sub>S; Elemental Analysis: Calculated (C, H, N, S) 78.53, 4.77, 9.47, 7.23. Found: 79.31, 5.47, 10.25, 8.45.

# Conclusion:

- ▶ In conclusion, a novel series of 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole **5(a-o)** was obtained using green synthetic tool like ultra-sonication. Use of green method i.e. use of ultra-sonication as a green synthetic strategy shows certain benefits over conventional refluxing as follows: (1) reactions required much less time for completion and were carried at room temperature (2) rate of reaction enhanced (3) the use of very less amount of solvent ethanol (5) ecofriendly as the reactions are carried out in closed acoustic chamber (6) and shortened and clean work-up procedure. The potential of 5-(1-(substituted phenyl)-4,5-diphenyl-1H-imidazol-2-yl)-4-methylthiazole can be developed as antimicrobial agents and can be expected to act as an excellent scaffold for lead optimization and drug discovery.



## **Acknowledgements:**

- ▶ The authors are thankful to the Mrs. Fatima Rafiq Zakaria Chairman Maulana Azad Educational Trust, Principal Maulana Azad Postgraduate & Research Centre, Aurangabad and Dr. Zahid Zaheer, Principal, Y.B. Chavan College of Pharmacy, Dr. Rafiq Zakaria Campus, Aurangabad 431 001 (M.S.), India for providing the laboratory facility. UDN is very much thankful to Dr. Babasaheb Ambedkar Research and Training Institute (BARTI), Pune for Financial Support.

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