3.1 Introduction

Benzoxazole is an aromatic organic compound with a molecular formula C₇H₅NO, a benzene fused oxazole ring structure, and an odour similar to pyridine. Benzoxazole is used primarily in industry and research, and has no household use. Being a heterocyclic compound, benzoxazole finds use in research as a starting material for the synthesis of larger, usually bioactive compounds. It is found within the chemical structures of pharmaceutical drugs such as Flunoxaprofen. Its aromaticity makes it relatively stable, although as a heterocyclic, it has reactive sites which allow for functionalization. Oxazole and its derivatives are used as building block for biochemicals and pharmaceutical as well as in other industrial applications such as pesticides, dyes, fluorescent brightening agents, textile auxiliaries and plastics.

![Figure 1: General structure of benzoxazole](image)

Benzoxazoles are an important class of heterocyclic compounds that have many applications in medicinal chemistry. Benzoxazole derivatives have been characterized as melatonin receptor agonists,¹ amyloidogenesis inhibitors,² Rho kinase inhibitors,³ and antitumor agents.⁴ In addition to their use in medicinal chemistry, benzoxazoles are recognized as an important scaffold in fluorescent probes such as anion and metal cation sensors.⁵ Benzoxazoles are an important class of heterocycles that are encountered in a number of natural products and are used in drug and agrochemical discovery programs, as well as for a variety of other purposes (Figure 1). For example, the benzoxazole core structure is found in a variety of cytotoxic natural products, such as the UK-1,⁶ AJI9561,⁷ and salvianen.⁸ Recent medicinal chemistry applications of benzoxazoles include the cathepsin S inhibitor,⁹ selective peroxisome proliferator-activated receptor γ antagonist
JTP-426467. Other applications of benzoxazoles include their use as herbicides, such as Fenoxaprop, and as fluorescent whitening agent dyes such as bisbenzoxazolyl ethenies and arenes.

Figure 2: Benzoxazole natural products and medicinal/agrochemical applications of benzoxazoles.

3.2 Literature survey

Mainly there are two general methods for synthesizing 2-substituted benzoxazoles. One is the coupling of $o$-substituted aminoaromatics with carboxylic acid derivatives and acyl chlorides, which is either catalyzed by strong acids or microwave conditions. The other is the oxidative cyclization of phenolic Schiff bases derived from the condensation of $o$-substituted aminoaromatics and aldehydes. In latter reactions various oxidants have been used. Different catalysts and different methods were also reported for the synthesis of these benzoxazole derivatives.

Pang Yi et al., described the synthesis of substituted benzoxazoles by using palladium mediated oxidative cyclization.
Chakraborti et al.,\textsuperscript{13} described a method for direct coupling of carboxylic acids with 2-aminophenol under microwave conditions to get 2-substituted benzoxazoles under metal and solvent-free conditions.

\[
\begin{array}{c}
\text{O} \\
\text{N} \\
\text{OH}
\end{array}
\xrightarrow{\text{Pd(OAc)}_2 \ 5\%}
\begin{array}{c}
\text{O} \\
\text{N} \\
\text{OH}
\end{array}
\]

Chakraborti et al.,\textsuperscript{14} described that methanesulphonic acid has been found to be a highly effective catalyst for a convenient and one-pot synthesis of 2-substituted benzoxazoles by the reaction of 2-aminophenol with acid chlorides.

\[
\begin{array}{c}
\text{OH} \\
\text{NH}_2
\end{array}
\xrightarrow{\text{R(Ar)} \ \text{microwave} \ 20\min}
\begin{array}{c}
\text{O} \\
\text{N}
\end{array}
\]

Punniyamurthy et al.,\textsuperscript{15} developed a method for copper(II)-catalyzed conversion of bis aryloxime ethers to 2-arylbenzoxazoles. The reaction involves a cascade C–H functionalization and C–N/C–O bond formation under oxygen atmosphere.

\[
\begin{array}{c}
\text{O} \\
\text{N}
\end{array}
\xrightarrow{\text{Cu(OTf)}_2 \ (20\ \text{mol}\%)}
\begin{array}{c}
\text{O} \\
\text{N}
\end{array}
\]

Player et al.,\textsuperscript{16} developed for synthesis of benzoxazoles by using microwave-assisted dielectric heating.
Masahiko Hayashi et al.,\textsuperscript{17} described that 2-arylbenzoxazoles were directly synthesized from substituted 2-aminophenols and aldehydes in the presence of activated carbon (Darco KB) in Xylene under an oxygen atmosphere.

\[
\text{R}_1 \text{NH}_2 \text{OH} + \text{R}_2 \text{OH} \xrightarrow{\text{Activated carbon, Xylene}} \text{R}_1 \text{N} - \text{O} - \text{R}_2
\]

Wang, Lei et al.,\textsuperscript{18} reported for the synthesis of benzoxazole derivatives through the reaction of substituted 2-aminophenols and acyl chlorides in the presence of catalytic amount of In(OTf)_3 under solvent-free reaction conditions.

\[
\text{R}_1 \text{NH}_2 \text{OH} + \text{ClOOC} \xrightarrow{\text{In(OTf)}_3 (5 \text{ mol\%})} \text{Solvent-free}} \text{Y}
\]

Pan et al.,\textsuperscript{19} described that the Schiff base derived from the condensation of \(\alpha\)-aminophenol with benzaldehydes was induced to undergo oxidative cyclization in the presence of DDQ. The resulting 2-arylbenzoxazoles were separated from the reduced DDQ by-product by treatment of reaction mixture with a strongly basic ion-exchange resin.

\[
\text{R} \text{NH}_2 \text{OH} \xrightarrow{\text{ArCHO, DDQ}} \text{R} \text{N} - \text{O} - \text{Ar}
\]

Shim et al.,\textsuperscript{20} reported that 2-amino phenols react with an array of carboxylic acids in Dioxane at 180\(^\circ\)C in the presence of tin(II)chloride to afford the corresponding 2-substituted benzoxazole in good yields.

\[
\text{R} \text{NH}_2 \text{OH} + \text{PhCOOH} \xrightarrow{\text{SnCl}_2, \text{Dioxane, 180\(^\circ\)C}} \text{R} \text{N} - \text{O} - \text{Ph}
\]

Mohammadpoor-Baltork et al.,\textsuperscript{21} described an efficient method for the preparation of benzoxazoles, benzimidazoles and oxazolo[4,5-\(b\)]pyridines from reactions of orthoesters.
with $o$-substituted aminoaromatics and 2-amino-3-hydroxypyridine in the presence of silica sulfuric acid under heterogeneous and solvent-free conditions.

\[
\text{R}^\text{Y} \text{N}^\text{H}_2 + \text{R}_3\text{C(OR)}_2 \xrightarrow{\text{Silica sulfuric acid}} \text{R}^\text{Y} \text{N}^\text{X} \text{R}_1 + 3\text{R}_2\text{OH}
\]

$Y = \text{C, N}$  
$X = \text{O, NH}$  
$R = \text{H, Cl, Me}$  
$R_1 = \text{H, Me, Et}$  
$R_2 = \text{Me, Et}$

Kumar et al.,\textsuperscript{22} reported that 2-amino phenols react with aldehydes in Dioxane at reflux in the presence of silica supported sodium hydrogen sulphate to afford the corresponding 2-substitued benzoxazole in good yields.

\[
\text{H}^\text{O} + \text{H}^\text{C} \xrightarrow{\text{NaHSO}_4\text{-SiO}_2, \text{Dioxane}} \text{N}^\text{Y} \text{O}^\text{X}^\text{H}
\]

John Blacker et al.,\textsuperscript{23} developed ruthenium-catalyzed hydrogen-transfer reactions for the conversion of alcohols into benzimidazoles and aldehydes into benzoxazoles and benzothiazoles.

However, many of these methods suffer from one or more drawbacks such as requirement of strong acidic conditions, long reaction times, low yields, tedious workup procedures, requirement of excess amounts of reagents, and use of toxic reagents, catalysts or solvents. Therefore, there is a strong demand for a highly efficient and environmentally benign method for the synthesis of these heterocycles.
Zinc (II) trifluoromethanesulphonate (zinc triflate) has recently been shown to be a versatile reagent for organic synthesis and it is used as a mild Lewis acid catalyst for wide range of organic transformations.\textsuperscript{24-26} Zinc triflate is commercially available or it may be prepared from reacting trifluoromethanesulphonic acid reacting with zinc carbonate in methanol.\textsuperscript{27}

### 3.3 Main objective of the present work

This chapter deals with the synthesis of 2-substituted benzoxazole derivatives through the reaction of \textit{o}-amino phenol coupled with different aldehydes by using Zinc(II) trifluoromethanesulphonate (zinc triflate) as a catalyst under reflux in ethanol solvent.

### 3.4 Results and Discussion

In order to find the optimum reaction conditions for the condensation reaction, preliminary efforts were mainly focused on the evaluation of different solvents. The model reaction has been carried out between 2-aminophenol and simple benzaldehyde in the presence of zinc triflate catalyst under different solvents, different mole ratios and at different temperatures and obtained results are shown in Table-1.

![Scheme-1](image_url)
Table-1: Optimization of the reaction conditions

<table>
<thead>
<tr>
<th>S.No</th>
<th>Solvent</th>
<th>Time(hr)</th>
<th>Temp( °C)</th>
<th>Zn(OTf)₂</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>MDC</td>
<td>10</td>
<td>40</td>
<td>10 mol%</td>
<td>45</td>
</tr>
<tr>
<td>02</td>
<td>EDC</td>
<td>10</td>
<td>80</td>
<td>10 mol%</td>
<td>62</td>
</tr>
<tr>
<td>03</td>
<td>MeOH</td>
<td>08</td>
<td>65</td>
<td>10 mol%</td>
<td>70</td>
</tr>
<tr>
<td>04</td>
<td>EtOH</td>
<td>05</td>
<td>80</td>
<td>10 mol%</td>
<td>91</td>
</tr>
<tr>
<td>05</td>
<td>THF</td>
<td>12</td>
<td>65</td>
<td>10 mol%</td>
<td>55</td>
</tr>
<tr>
<td>06</td>
<td>Toluene</td>
<td>15</td>
<td>100</td>
<td>10 mol%</td>
<td>30</td>
</tr>
<tr>
<td>07</td>
<td>Solvent-free</td>
<td>12</td>
<td>100</td>
<td>10 mol%</td>
<td>70</td>
</tr>
<tr>
<td>08</td>
<td>EtOH</td>
<td>05</td>
<td>80</td>
<td>5 mol%</td>
<td>86</td>
</tr>
<tr>
<td>09</td>
<td>EtOH</td>
<td>05</td>
<td>80</td>
<td>20 mol%</td>
<td>90</td>
</tr>
</tbody>
</table>

The effect of solvent, catalyst, reaction temperature and time on the reaction was systematically investigated and the results were summarized in Table-1. As can be seen from Table-1, the solvent play an important role in the model reaction, it was found that ethanol was found best to be the among the solvents tested, and the reaction proceeded smoothly in ethanol and gave the desired product in 91% yield, while toluene afforded the product only in 30%, use of methanol, THF, dichloro methane, and 1,2-dichloroethane as solvents led to slower reactions and 70% yield of model product was isolated in solvent-free reaction condition. The optimized reaction conditions for the reaction were found to be Zn (OTf)₂ under reflux in ethanol solvent for 5h.

In the preliminarily investigation on the model reaction of 2- amino phenol and benzaldehyde, it was found that the reaction could be finished under very simple reaction conditions in the presence of zinc(II) triflate (10 mol %) in reflux of ethanol solvent, which gives the desired benzoazol product in good yield. (Scheme-1)
Having established the optimized reaction conditions, attention was turned over exploration of the scope of this protocol. The results were listed in Table-2. As shown in Table-2, in the most of cases 2-aminophenol reacted with a wide variety of substituted benzaldehydes completely and afforded the corresponding benzoxazoles in good to excellent yields.
Table-2: synthesis of 2-substituted benzoxazoles from 2-aminophenol and different aldehydes\textsuperscript{a}.

<table>
<thead>
<tr>
<th>Entry</th>
<th>2-aminophenol</th>
<th>aldehyde</th>
<th>Benzoxazole</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}]</td>
<td>[\text{N}\text{O}][MeO]</td>
</tr>
<tr>
<td>2</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{OMe}]</td>
<td>[\text{N}\text{O}][MeO]</td>
</tr>
<tr>
<td>3</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{Cl}]</td>
<td>[\text{N}\text{O}][Cl]</td>
</tr>
<tr>
<td>4</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{Br}]</td>
<td>[\text{N}\text{O}][Br]</td>
</tr>
<tr>
<td>5</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{F}]</td>
<td>[\text{N}\text{O}][F]</td>
</tr>
<tr>
<td>6</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{Me}]</td>
<td>[\text{N}\text{O}][Me]</td>
</tr>
<tr>
<td>7</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{OMe}]</td>
<td>[\text{N}\text{O}][OMe]</td>
</tr>
<tr>
<td>8</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{Cl}]</td>
<td>[\text{N}\text{O}][Cl]</td>
</tr>
<tr>
<td>9</td>
<td>[\text{OH}]</td>
<td>[\text{CHO}][\text{Me}]</td>
<td>[\text{N}\text{O}][OMe]</td>
</tr>
</tbody>
</table>

\textsuperscript{a}
Reaction conditions: 2-Amino phenol (1 mmol), aldehyde (1.2 mmol), Zn(OTf)₂ (10 mol%) was stirred for 5h under reflux in ethanol solvent. bIsolated yield. All compounds are matched with their authentic data.

Given these results, an array of aminophenol and substituted aldehydes was employed in order to investigate the scope of the reaction. The results are summarized in Table-2. Aldehydes were readily cyclized with 2-aminophenol and these preliminary results indicate that benzoxazole yield is affected by the position of the substituent on aromatic ring of the aldehydes. *Ortho*-substituted aryl aldehyde (Entry 2-6), the yield was lower than that when *Meta-* and *Para*- substituted aryl aldehydes were used. Also, the results found in (Entry 7-9), may indicate that the yield is dependent on the electronic nature of the substituent as well.

**3.5 Conclusion**

In conclusion, we have demonstrated that 2-substituted benzoxazoles can be synthesized from 2-aminophenols and aldehydes in the presence of Zn (OTf)₂ in good yields. The present zinc triflate mediated reaction is an alternative route to benzoxazole synthesis using 2-aminophenols and aldehydes.

**3.6 Experimental Section**

All the melting points were determined from the open capillary method and were uncorrected. The ¹H and ¹³C NMR were recorded on 400 MHz Varian FT-NMR
spectrometer with tetramethysilane (TMS) as the internal standard. The solvents used for NMR analysis were CDCl$_3$ and DMSO-$d_6$. The infrared (IR) spectra were obtained using Perkin-Elmer’s FT-IR spectrophotometer. The mass spectra were recorded on Waters ZQ-4000 equipped with ESI and API mass detector. The Carbon, Hydrogen and Nitrogen (CHN) analysis was done on Perkin-Elmer PE 2400 Series II machine. The thin layer chromatography (TLC) was performed either using the Merck precoated TLC plates or on ACME’s silica gel with 13% calcium sulphate (CaSO$_4$) as binder and the components were visualized under iodine chamber or by UV exposure or by the potassium permanganate (KMnO$_4$) spray technique. Flash column chromatography was performed using Merck silica gel (100-200 mesh). The chemicals and solvents were purchased from commercial suppliers either from Aldrich, Spectrochem, and Sisco research laboratories (SRL), and they were used without purification prior to use.

**Zinc triflate catalyzed synthesis of 2-substituted benzoxazoles from 2-aminophenols and aldehydes.**

A mixture of 2-amino phenol (1 mmol), aldehyde (1.2 mmol) and Zn(OTf)$_2$ (10 mol %) in ethanol (5 ml) was placed in a 50 ml round bottom flask and stirred at reflux for 5h. The progress of the reaction was monitored by TLC Hexane: EtOAc (9:1) after completion of the reaction, the reaction mixture was cooled and treated by dilution with 1N NaOH (5 mL). The solution was extracted with EtOAc (3x10 mL) Total organic layer was washed with water, brine solution and dried over Na$_2$SO$_4$ and evaporated under vacuum. The crude residue then obtained was purified by column chromatography to give 2- substituted benzoxazoles.

### 3.7 Physical, Spectral and Analytical Data of compounds (Entry 1-12, Table-2)

**2-Phenyl benzo[d]oxazole (Table-2, entry 1)**

\[
\begin{array}{c}
\text{O} \\
\text{N} \\
\end{array}
\begin{array}{c}
\text{Ph} \\
\end{array}
\]
This compound was obtained as white solid, m.p. 102-104°C; $^1$H NMR (CDCl$_3$): δ 8.27-8.24 (m, 2H), 7.79-7.76 (m, 1H), 7.60-7.57 (m, 1H), 7.54-7.51 (m, 3H), 7.38-7.32 (m, 2H); (LC-MS) m/z: 196.20 [M+H]$^+$

2-(2-Methoxyphenyl)benzoxazole (Table-2, entry 2)$^{29}$

This compound was obtained as white solid, m.p. 54-56°C; $^1$H NMR (CDCl$_3$): δ 8.13 (d, $J$ = 8.8 Hz, 1H), 7.83-7.80 (m, 1H), 7.60-7.57 (m, 1H), 7.51-7.47 (m, 1H), 7.35-7.32 (m, 2H), 7.13-7.07 (m, 2H), 4.02 (s, 3H); (LC-MS) m/z: 226.10 [M+H]$^+$

2-(2-Chlorophenyl)benzoxazole (Table-2, entry 3)$^{30}$

This compound was obtained as white solid, m.p. 70-73°C; $^1$H NMR (CDCl$_3$): δ 8.15 (dd, $J$ = 1.6, 5.6 Hz, 1H), 7.87-7.83 (m, 1H), 7.64-7.61 (m, 1H), 7.59-7.56 (m, 1H), 7.48-7.37 (m, 4H); (LC-MS) m/z: 230.12 [M+H]$^+$

2-(2-Bromophenyl)benzoxazole (Table-2, entry 4)$^{29}$

This compound was obtained as white solid, m.p. 53-56°C; $^1$H NMR (CDCl$_3$): δ 8.06 (d, $J$ = 8 Hz, 1H), 7.86-7.83 (m, 1H), 7.76 (d, $J$ = 8.0 Hz, 1H), 7.63-7.60 (m, 1H), 7.48-7.32 (m, 4H); (LC-MS) m/z: 273.95, 275.90 [M+H]$^+$
2-(2-Fluorophenyl)benzoxazole (Table-2, entry 5)\(^{31}\)

![2-(2-Fluorophenyl)benzoxazole](image)

This compound was obtained as white solid, m.p. 92-94\(^{\circ}\)C; \(^1\)H NMR (CDCl\(_3\)): \(\delta 8.24-8.22 \text{ (m, 1H)}, 7.85-7.82 \text{ (m, 1H)}, 7.63-7.61 \text{ (m, 1H)}, 7.54-7.52 \text{ (m, 1H)}, 7.39-7.37 \text{ (m, 2H)}, 7.33-7.26 \text{ (m, 2H)}; \) (LC-MS) m/z: 214.16 [M+H]\(^+\)

2-o-tolylbenzoxazole (Table-2, entry 6)\(^{32}\)

![2-o-tolylbenzoxazole](image)

This compound was obtained as off white solid, m.p. 63-66\(^{\circ}\)C; \(^1\)H NMR (CDCl\(_3\)): \(\delta 8.18-8.16 \text{ (m, 1H)}, 7.81-7.79 \text{ (m, 1H)}, 7.60-7.58 \text{ (m, 1H)}, 7.33-7.41 \text{ (m, 5H)}, 2.81 \text{ (s, 3H)}; \) (LC-MS) m/z: 210.14 [M+H]\(^+\)

2-(3-Methoxyphenyl)benzoxazole (Table-2, entry 7)\(^{31}\)

![2-(3-Methoxyphenyl)benzoxazole](image)

This compound was obtained as white solid, m.p. 70-73\(^{\circ}\)C; \(^1\)H NMR (CDCl\(_3\)): \(\delta 7.86-7.76 \text{ (m, 3H)}, 7.60-7.57 \text{ (m, 1H)}, 7.43 \text{ (t, J = 8 Hz, 1H)}, 7.36-7.34 \text{ (m, 2H)}, 7.10-7.07 \text{ (m, 1H)}, 3.92 \text{ (s, 3H)}; \) (LC-MS) m/z: 226.23 [M+H]\(^+\)

2-(3-Chlorophenyl)benzoxazole (Table-2, entry 8)\(^{30}\)

![2-(3-Chlorophenyl)benzoxazole](image)
This compound was obtained as white solid, m.p. 131-133°C; $^1$H NMR (CDCl$_3$): δ 8.26 (s, 1H), 8.16-8.13 (m, 1H), 7.80-7.77 (m, 1H), 7.61-7.58 (m, 1H), 7.52-7.44 (m, 2H), 7.39-7.37 (m, 2H); (LC-MS) m/z: 230.12 [M+H]$^+$

2-(4-Methoxyphenyl)benzoxazole (Table-2, entry 9)$^{28}$

This compound was obtained as white solid, m.p. 97-99°C; $^1$H NMR (CDCl$_3$): δ 8.20 (d, J = 9.2 Hz, 2H), 7.74-7.72 (m, 1H), 7.56-7.54 (m, 1H), 7.35-7.31 (m, 2H), 7.03 (d, J = 9.2 Hz, 2H), 3.89 (s, 3H); (LC-MS) m/z: 226.23 [M+H]$^+$

2-($p$-tolyl)benzoxazole (Table-2, entry 10)$^{28}$

This compound was obtained as white solid, m.p. 114-116°C; $^1$H NMR (CDCl$_3$): δ 8.15 (d, J = 8 Hz, 2H), 7.77-7.75 (m, 1H), 7.58-7.56 (m, 1H), 7.35-7.32 (m, 4H), 2.44 (s, 3H); (LC-MS) m/z: 210.20 [M+H]$^+$

2-(furan-2-yl)benzoxazole (Table-2, entry 11)$^{28}$

This compound was obtained as white solid, m.p. 85-87°C; $^1$H NMR (CDCl$_3$): δ 7.77-7.75 (m, 1H), 7.68-7.67 (m, 1H), 7.58-7.55 (m, 1H), 7.37-7.35 (m, 2H), 7.28 (d, J = 3.6 Hz, 1H), 6.62 (dd, J = 3.2, 2 Hz, 1H); (LC-MS) m/z: 186.02 [M+H]$^+$

2-(thiophen-2-yl)benzoxazole (Table-2, entry 12)$^{28}$
This compound was obtained as white solid, m.p. 104-107°C; $^1$H NMR (CDCl$_3$): \( \delta \) 7.92-7.91 (m, 1H), 7.75-7.72 (m, 1H), 7.57-7.54 (m, 2H), 7.36-7.33 (m, 2H), 7.21-7.19 (m, 1H); (LC-MS) m/z: 202.06 [M+H]$^+$

**Melting point comparison table:**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Compound</th>
<th>Mol. Wt</th>
<th>Mol. Formula</th>
<th>Melting point (°C)</th>
<th>Obtained</th>
<th>Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>2-Phenylbenzoxazole</td>
<td>195.22</td>
<td>C13H9NO</td>
<td>102-104</td>
<td>101-102</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>2-(2-Methoxy phenyl) benzoxazole</td>
<td>225.24</td>
<td>C14H11NO2</td>
<td>54-56</td>
<td>53-54</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>2-(2-Chloro phenyl) benzoxazole</td>
<td>229.66</td>
<td>C13H8ClNO</td>
<td>70-73</td>
<td>70-72</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>2-(2-Bromo phenyl) benzoxazole</td>
<td>274.11</td>
<td>C13H8BrNO</td>
<td>53-56</td>
<td>54-55</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>2-(2-Fluoro phenyl) benzoxazole</td>
<td>213.21</td>
<td>C13H8FNO</td>
<td>92-94</td>
<td>93-95</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>2-o-tolylbenzoxazole</td>
<td>209.24</td>
<td>C14H11NO</td>
<td>63-66</td>
<td>64-65</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>2-(3-Methoxy phenyl) benzoxazole</td>
<td>225.24</td>
<td>C14H11NO2</td>
<td>70-73</td>
<td>72-74</td>
<td></td>
</tr>
<tr>
<td>08</td>
<td>2-(3-Chloro phenyl) benzoxazole</td>
<td>229.66</td>
<td>C13H8ClNO</td>
<td>131-133</td>
<td>131-132</td>
<td></td>
</tr>
<tr>
<td>09</td>
<td>2-(4-Methoxy phenyl) benzoxazole</td>
<td>225.24</td>
<td>C14H11NO2</td>
<td>97-99</td>
<td>98-99</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2-p-tolylbenzoxazole</td>
<td>209.24</td>
<td>C14H11NO</td>
<td>114-116</td>
<td>110-111</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>2-(furan-2-yl)benzoxazole</td>
<td>185.18</td>
<td>C11H7NO2</td>
<td>85-87</td>
<td>84-86</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>2-(thiophen-2-yl) benzoxazole</td>
<td>201.24</td>
<td>C11H7NOS</td>
<td>104-107</td>
<td>104-105</td>
<td></td>
</tr>
</tbody>
</table>
$^1$H NMR Spectrum of 2-Phenyl benzo[d]oxazole
IR Spectrum of 2-Phenyl benzo[d]oxazole
MASS Spectrum of 2-Phenyl benzo[d]oxazole
$^1$H NMR Spectrum of 2-(2-Chlorophenyl)benzoxazole
\(^1\)H NMR Spectrum of 2-(3-Chlorophenyl)benzoxazole
$^1$H NMR Spectrum of 2-(4-Methoxyphenyl)benzoxazole
\(^1\)H NMR Spectrum of 2-p-tolylbenzoxazole
$^1$H NMR Spectrum of 2-(thiophen-2-yl)benzoxazole
3.8 References