CHAPTER-2

SYNTHESIS OF NEW SERIES OF PYRAZOLO INDOLOQUINOXALINE COMPOUNDS

2.1 Introduction

Heterocycles form by far the largest of the classical divisions of organic chemistry and are of immense importance biologically, industrially and indeed to the functioning of any developed human society. The majority of the pharmaceuticals and biologically active agrochemicals are heterocyclic, as are countless additives and modifiers used in industries varied as cosmetics, reprography, information storage and plastics.

Synthesis of substituted quinoxaline derivatives at desired positions and their fusion with other heterocyclic moieties like pyrazole, benzimidazole and benzothiazole plays a key role in showing various pharmacological activities like antioxidant, anti-inflammatory, antibacterial, antifungal and antihistaminic activity.

Quinoxaline, indolo quinoxaline and pyrazoline are also playing major role in various biologically active drugs as heterocyclic structural parts. Synthesis of pyrazolo indolo quinoxaline compounds are more important because of their pharmacological properties.
2.2 Present work:

The biological properties exhibited by indolo quinoxalines, quinoxalines and pyrazoles, are well documented in literature survey (chapter-1). Owing to their applications as pharmaceutical agents, we have planned to fuse indoloquinoxaline with quinoxaline and then acetylate the indole group to produce different chalcones and then they are converted into pyrazoles on treating with different acid hydrazides to synthesize new pyrazolo indoloquinoxaline compounds comprising moieties like quinoxaline, indolo quinoxaline and pyrazole. This is expected to enhance the biological profile of the compounds formed. Hence in this chapter the synthesis of pyrazolo indoloquinoxaline derivatives are described.

2.3 Results and discussion:-
Treatment of benzil (2.4) with o-phenylenediamine (2.5) under Phillips condensation gave the previously reported 2,3 diphenyl quinoxaline (2.6). (Scheme-2.1)\textsuperscript{10,11}.

\[
\begin{array}{c}
\text{(2.4)} \quad \text{+} \quad \text{(2.5)} \quad \xrightarrow{\text{C}_2\text{H}_4\text{OH}} \quad \text{(2.6)}
\end{array}
\]

Later both (2.8) and (2.6) were linked with methylene bridge\textsuperscript{13} to give 2-((2,3- diphenylquinoxalin-6-yl) methyl) -6H- indolo [2,3-b] quinoxaline (2.9), on treatment with 35% HCl at 50\textdegree C and 35 parts formaldehyde solution.(Scheme -2.3)

Treatment of Isatin (2.7) with o-Phenylenediamine under Phillips condensation\textsuperscript{12} gave the previously reported 6H-Indolo [2,3-b] quinoxaline (2.8) (Scheme-2.2)

\[
\begin{array}{c}
\text{(2.7)} \quad \text{+} \quad \text{(2.5)} \quad \xrightarrow{\text{C}_2\text{H}_4\text{OH}} \quad \text{(2.8)}
\end{array}
\]
The structure of \( \text{(2.9)} \) was characterized by its spectral data. Thus its IR in KBr (Fig-2.1) showed absorption peaks at 1389 Cm\(^{-1}\) (-CH str, methylene), 1340 Cm\(^{-1}\) (C-N Str, indolo quinoxaline), 3120 Cm\(^{-1}\) (-NH str, indole), 1660 Cm\(^{-1}\) (C=N Str, quinoxaline). Its \(^1\)H-NMR in (CDCl\(_3\) / TMS) (Fig-2.2) showed signals at \( \delta \) 7.50-7.95 (m, 6H, quinoxaline), 10.30 (s, 1H, N-H indolo quinoxaline), 7.20-7.50 (m, 10 H, phenyl), 3.81 (s, 2H, -C-\(^*\)CH\(_2\)-C-), 7.00-7.50 (m, 4H, C-H indole ring). Its m/z value was found to be 513.7. (Fig-2.3)

Compound \( \text{(2.9)} \) on acetylation with chloro acetone using dry acetone and anhydrous potassium carbonate yielded N-acetylated product\(^{14,15}\) \(1\)-\((2\)-(2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)propan-2-one \( \text{(2.10)} \) (Scheme2.4).
...Scheme-2.4
Indian Institute of Chemical Technology, Hyderabad
FTIR Analysis Report

Sample Name: IQ III Reg. No. 1793
Sample Preparation:
Collection time: Wed 27 17:51:51 2008 (GMT+05:30)
Bench: Thermo Nicolet Nexus 670 Spectrometer

Detector: DTGS KBr
Beam splitter: KBr
Source: IR

Fig-2.1: I.R Spectra of 2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxaline (2.9)
Fig. 2.2: $^1$H N.M.R. Spectra of 2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxaline (2.9)
Fig. 2.3: Mass Spectra of 2-[(2,3-diphenyloxazol-6-yl)methyl]-6H-indolo[2,3-b]quinoxaline (2.9)
**Mechanism of Acetylation:**

An Amine can react with acetyl halide to produce an amine of next higher group, here on treating with acetyl chloride the 2° amine, (2.9) is converted to 3°amine (2.10). Spectral data of (2.10) was used for structural characterization. Thus its IR in KBr **(Fig-2.4)** showed absorption peaks at 1712 Cm⁻¹ (C=O Str, acetyl), 1340 Cm⁻¹ (C-N Str, Indolo quinoxaline), 1675 Cm⁻¹ (C=N Str, quinoxaline), 1400-1350 Cm⁻¹ (C-H Str of methylene and C-H Str of methyl). Its ¹H-NMR in (CDCl₃ / TMS ) **(Fig-2.5)** showed signals at δ 7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 (s, 2H, -C-*CH₂-C-), 7.20-7.50 (m, 10 H, phenyl), 5.01 (s, 2H, -N-*CH₂-CO-), 2.01( s, 3H, methyl). Its m/z value was found to be 569.3. **(Fig-2.6).**
Fig-2.4: I.R. Spectra of 1-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl]propan-2-one (2.10)
Fig. 2.5: $^1$H N.M.R. Spectra of 1-{2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl} propan-2-one (2.10)
Fig. 2.6: Mass Spectra of 1-(2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl) propan-2-one (2.10)
The method of aldol reaction was followed and the formed acetylated product (2.10) was treated with aromatic aldehydes like benzaldehyde to give (E) – 4 – phenyl – 1 - (2- ((2,3- diphenylquinoxalin -6- yl) methyl)-6H-indolo[2,3-b] quinoxalin -6-yl)but-3-en-2-one, chalcone\textsuperscript{16} (2.11a) (Scheme 2.5)

**Mechanism of aldol condensation:**

![Mechanism of aldol condensation diagram]
Compound (2.11a) was characterized by its spectral data. Thus its IR in KBr (Fig-2.7) showed absorption peaks at 1712 Cm\(^{-1}\) (C=O Str, chalcone), 1675 Cm\(^{-1}\) (C=N Str, quinoxaline) 1620 Cm\(^{-1}\) (C=C Str, chalcone), 1343 Cm\(^{-1}\) (C-H Str, methylene). Its \(^{1}\)H-NMR in (CDCl\(_3\) / TMS ) (Fig-2.8) showed signals at \(\delta\) 7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.82 ( s, 2H, -C-*CH\(_2\)-C-), 7.30-7.50 (m, 15 H, phenyl), 5.50 ( s, 2H, -N-*CH\(_2\)-CO-), 6.6, 7.5 (d, 2H, ethylene). Its m/z value was found to be 657.6 (Fig-2.9).

The above reaction was found to be a general one and the acetylated product (2.10) was then treated with \(p\)-hydroxy benzaldehyde in the presence of NaOH solution and ethanol under cold conditions to give (E)-4-(4-hydroxy phenyl) -1-(2-((2,3-diphenyl quinoxalin -6-yl)methyl) -6H-indolo [2,3-b] quinoxalin-6-yl)but-3-en-2-one (2.11b) (Scheme-2.9) and was characterized by its spectral data. (Fig - 2.10, Fig - 2.11, Fig - 2.12). For details please see the experimental section (Table- 2.3). Compound (2.10) was then treated with \(p\)-fluoro benzaldehyde, \(p\)-chloro benzaldehyde and anisaldehyde in the presence of NaOH solution and ethanol under cold conditions to give (2.11c), (2.11d) and (2.11e) respectively. (Scheme-2.5). Spectral data was used for the characterization of above compounds. For details please see the experimental section (Table- 2.3).
Fig 2.7: I.R. Spectra of (E) - 4 - phenyl - 1 - (2 - ((2,3- diphenyl quinoxalin -6- yl) methyl)-6H-indolo [2,3-b] quinoxalin -6-yl)but-3-en-2-one (2.11a)
Fig 2.8: $^1$H N.M.R. Spectra of (E) - 4 - phenyl - 1 - (2 - [(2,3- diphenyl quinoxalin-6-yl) methyl]-6H-indolo[2,3-b] quinoxalin-6-yl) but-3-en-2-one (2.11a)
Fig. 2.9: Mass Spectra of (E)-4-phenyl-1-(2-((2,3-diphenyl quinoxalin-6-yl) methyl)-6H-indol[2,3-b] quinoxalin-6-yl)but-3-en-2-one (2.11a)
Fig-2.10: I.R. Spectra of (E)-4-(4-hydroxyphenyl)-1-[(2-[2,3-diphenylquinoxalin-6-yl]methyl)-6H-indolo[2,3-b]quinoxalin-6-yl]but-3-en-2-one (2.11b)
Fig-2.11: $^1$H N.M.R. Spectra of (E)-4-(4-hydroxyphenyl)-1-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl]but-3-en-2-one (2.11b)
Fig-2.12: Mass Spectra of (E)-4-(4-hydroxyphenyl)-1-(2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)but-3-en-2-one (2.11b)
Fig-2.13: I.R. Spectra of (E)-4-(4-fluorophenyl)-1-(2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)but-3-en-2-one (2.11c)
Fig-2.14: $^1$H N.M.R. Spectra of (E)-4-(4-fluorophenyl)-1-(2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)but-3-en-2-one (2.11c)
Fig-2.15: Mass Spectra of (E)-4-((4-fluorophenyl)-1-((2-(2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)but-3-en-2-one (2.11c)
Fig. 2.16: I.R. Spectra of (E)-4-(4-chlorophenyl)-1-(2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)but-3-en-2-one (2.1.1d)
Fig-2.17: $^1$H N.M.R. Spectra of (E)-4-(4-chlorophenyl)-1-{2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl]but-3-en-2-one (2.11d)
Fig-2.18: Mass Spectra of (E)-4-(4-chlorophenyl)-1-(2-[(2,3-diphenyl)quinazolin-6-yl]methyl]-6H-indolo[2,3-b]quinazolin-6-yl]but-3-en-2-one (2.11d)
Fig. 2.19: I.R. Spectra of (E)-4-(4-methoxyphenyl)-1-(2-((2,3-diphenylquinazolin-6-yl)methyl)-6H-indolo[2,3-b]quinazolin-6-yl)but-3-en-2-one (2.11e)
Fig-2.21: Mass Spectra of (E)-4-(4-methoxyphenyl)-1-[(2,3-diphenylquinazolin-6-yl)methyl]-6H-indolo[2,3-b]quinazolin-6-yl]but-3-en-2-one (2.11e)
Benzoic acid hydrazide was refluxed with (2.11a) in the presence of glacial acetic acid at 130°C to give (4,5-dihydro-5-phenyl-3-[(2-((2,3-diphenylquinoxalin-6-yl) methyl )- 6H- indolo [2,3-b] quinoxalin - 6-yl )methyl ) pyrazol -1-yl)(phenyl) methanone (2.12a). (Scheme- 2.6)
Spectral data characterized the structure of (2.12a). Thus its IR in KBr (Fig-2.13) showed absorption peaks at 3030 Cm$^{-1}$ (Ar-H Str.), 1340 (C-N Str), 1675 Cm$^{-1}$ (C=N Str), 2945 Cm$^{-1}$ (C-H, Str), 1704 Cm$^{-1}$ (C=0 Str) as diagnostic absorptions. Its $^1$H-NMR in (CDCl$_3$ / TMS) (Fig-2.14) showed signals at δ 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -C-$^-$CH$_2$-C-), 7.00-7.90 (m, 20 H, phenyl ), 3.9 (s, 2H, -N-CH$_2$-C-), 4.9 (t, 1H, -CH$_2$-$^-$CH-C), 2.00,1.80 (d, 2H, -C-$^-$CH$_2$-C-). Its m/z value was found to be 775.5 (Fig-2.15).

Benzoic acid hydrazide was then refluxed with (2.11b), (2.11c), (2.11d), (2.11e) in the presence of glacial acetic acid at 130$^\circ$C to give (2.12b), (2.12c), (2.12d), and (2.12e) respectively. (Scheme-2.6). Spectral data was used for characterization of above compounds. For details please see the experimental section (Table 2.4).

The work was extended by using p-hydroxy benzoic acid hydrazide and it was refluxed with (2.11a) in the presence of glacial acetic acid to give (4,5-dihydro-5-phenyl-3-((2-(2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo [2,3-b] quinoxalin -6- yl ) methyl ) pyrazol -1-yl ) (4-hydroxy phenyl ) methanone (2.13a). (Scheme- 2.7)

The structure of (2.13a) was characterized by its spectral data. Thus its IR in KBr (Fig-2.16) showed absorption peaks at 3429 Cm$^{-1}$ (Broad O-H Str), 3033 Cm$^{-1}$ (Ar-H Str,) 1340 Cm$^{-1}$ (C-N Str), 1645 Cm$^{-1}$ (C=N Str), 2955 Cm$^{-1}$ (C-H, Str), 1700 Cm$^{-1}$ (C=0 Str), as diagnostic absorptions. Its $^1$H-NMR in (CDCl$_3$ / TMS) (Fig-2.17) showed signals at δ 5.00 (s, 1H, -OH), 6.90-
7.70 (m, 4H, -*C₆H₄-OH ) 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 (s, 2H, -C-*CH₂-C-), 6.90-7.48 (m, 15 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂-*CH-C), 2.00,1.80 (d, 2H, -C-*CH₂-C-). Its m/z value was found to be 791.2 (Fig-2.18).

p-Hydroxy Benzoic acid hydrazide was then refluxed with (2.11b), (2.11c), (2.11d) and (2.11e) in the presence of glacial acetic acid at 130°C to give (2.13b), (2.13c), (2.13d) and (2.13e) respectively (Scheme-2.7). Spectral data was used for characterization of above compounds. For details please see the experimental section (Table-2.5).

Further five more new quinoxaline compounds were prepared by using p-chloro Benzoic acid hydrazide. It was refluxed with (2.11a) in the presence of glacial acetic acid to give (4-chlorophenyl) (4, 5-dihydro-5-phenyl -3-(2-((2,3-diphenyl quinoxalin -6-yl) methyl)-6H- indolo [2,3b] quinoxalin -6-yl) methyl) pyrazol -1-yl) methanone (2.14a). (Scheme-2.8).

The spectral data of (2.14a) was used for the structural characterization. Thus its IR in KBr (Fig-2.19) showed absorption peaks at 697 Cm⁻¹ (C₆H₅-Cl Str), Cm⁻¹ (Ar-H Str, 1340 Cm⁻¹ (C-N Str), 1678 Cm⁻¹ (C=N Str), 2925 Cm⁻¹ (C-H, Str), 1700 Cm⁻¹ (C=0 Str), as diagnostic absorptions. Its ¹H-NMR in (CDCl₃ / TMS ) (Fig-2.20) showed signals at δ 7.12-7.89 (m, 4H, *C₆H₄-Cl), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -C-*CH₂-C-), 7.00-7.90 (m, 15 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂-*CH-C), 2.00,1.80 (d, 2H, -C-*CH₂-C-). Its m/z value was found to be 809.0 (Fig-2.21).
p- chloro Benzoic acid hydrazide was then refluxed with (2.11b), (2.11c), (2.11d) and (2.11e) in the presence of glacial acetic acid at 130°C to give (2.14b), (2.11c), (2.11d), and (2.11e), respectively. (Scheme-2.8). Spectral data was used for characterization of above compounds. For details please see the experimental section (Table-2.6).
Fig-2.13: I.R. Spectra of \( (4,5\)-dihydro-5-phenyl-3-[(2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)methyl]pyrazol-1-yl) \) (phenyl) methanone (2.12a)
Fig-2.14: $^1$H N.M.R. Spectra of (4,5-dihydro-5-phenyl-3-[(2-(3-diphenyloxazolin-6-yl)methyl]-6H-indolo[2,3-b]quinazolin-6-yl)methyl]pyrazol-1-yl) (phenyl) methanone (2.12a)
Fig-2.15: Mass Spectra of (4,5-dihydro-5-phenyl-3-[(2-(3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl)methyl]pyrazol-1-yl) (phenyl) methanone (2.12a)
Fig 2.2S: I.R. Spectra of \((4,5\text{-dihydro}-5\text{-}(4\text{-hydroxyphenyl})-3\text{-}(2\text{-}(2,3\text{-diphenylquinoxalin-6-yl})\text{methyl})\text{6H-indolo[2,3-b]quinoxalin-6-yl})\text{methyl}pyrazol-1-yl\) (phenyl) methanone (2.12b)
Fig-2.26: $^1$H N.M.R. Spectra of (4,5-dihydro-5-(4-hydroxyphenyl)-3-[(2-(3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl]methyl)pyrazol-1-yl] (phenyl) methanone (2.12b)
Fig-2.27: Mass Spectra of \(4,5\)-dihydro-5-(4-hydroxyphenyl)-3-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl methyl]pyrazol-1-yl] [phenyl] methanone (2.12b)
Fig-2.28: I.R. Spectra of (5-(4-fluorophenyl)-4,5-dihydro-3-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl] methyl) pyrazol-1-yl) (phenyl) methanone (2.12c)
Fig-2.29: ¹H N.M.R. Spectra of (5-(4-fluorophenyl)-4,5-dihydro-3-([(2,3-diphenyloxazol-6-yl)methyl]-6H-indolo[2,3-b]quinolizin-6-yl]methyl)-6H-indolo[2,3-b]quinoxalin-6-yl methyl pyrazol-1-yl] (phenyl) methanone (2.12c)
Fig 2.30: Mass Spectra of (5-[4-fluorophenyl]-4,5-dihydro-3-[(2-[(2,3-dipheny1)quinoxalin-6-yl]methyl]-6H-indolo[2,3-b]quinoxalin-6-yl) methyl pyrazol-1-yl) (phenyl) methanone (2.12c)
Fig. 2.31: I.R. Spectra of [5-(4-chlorophenyl)-4,5-dihydro-3-{(2-(2,3-diphenylquinolizin-6-yl)methyl]-6H-indolo[2,3-b]quinolizin-6-yl} methyl]pyrazol-1-yl] (phenyl)methanone (2.12d)
Fig. 2.32: $^1$H N.M.R. Spectra of (5-[(4-chlorophenyl)-4,5-dihydro-3-[(2-{(2,3-diphenylquinazolin-6-yl)methyl}-6H-indolo[2,3-b]quinazolin-6-yl)methyl]pyrazol-1-yl]phenyl)methane (2.12d)
Fig-2.33: Mass Spectra of (5-{4-chlorophenyl}-4,5-dihydro-3-{2-[(2,3-diphenylquinazolin-6-yl)methyl]-6H-indolo[2,3-b]quinazolin-6-yl}methyl[pyrazol-1-yl][phenyl]methanone (2.12d)
Fig. 2.34: I.R. Spectra of (4,5-dihydro-5-[4-methoxyphenyl]-3-[[2-[[2,3-diphenylquinoxalin-6-yl]methyl]-6H-indolo[2,3-b]quinoxalin-6-yl]methyl]pyrazol-1-yl) phenyl)methanol (2.12e)
Fig-2.35: $^1$H N.M.R. Spectra of (4,5-dihydro-5-(4-methoxyphenyl)-3-[[2-[[2,3-diphenyiquinoxaline-6-y1]methyl]-6H-indolo[2,3-b]quinazolin-6-y1] methyl]pyrazol-1-y1) (phenyl)methanone [2.12e]
Fig. 2.36: Mass Spectra of (4,5-dihydro-8-{4-methoxyphenyl}-3-{{2-[(2,3-diphenyl[quinoxalin-6-yl)methyl]-6H-indolo[2,3-b][quinoxalin-6-yl] methyl]pyrazol-1-yl}[phenyl]methanone (2.12e)
Fig-2.16: I.R. Spectra of (4,5-dihydro-5-phenyl-3-[(2-[(2,3-diphenylquinazolin-6-yl)methyl]-6H-indolo[2,3-b]quinazolin-6-yl]methyl]pyrazol-1-yl)[4-hydroxy phenyl] methanone (2.13a)
Fig-2.17: $^1$H N.M.R. Spectra of (4,5-dihydro-5-phenyl-3-[(2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl)methyl]pyrazol-1-yl)(4-hydroxy phenyl) methanone (2.13a)
Fig 2.18: Mass Spectra of \((4,5\text{-dihydro-5-phenyl-3-[(2-[(2,3\text{-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl)methyl]pyrazol-1-yl][4-hydroxy phenyl] methanone (2.13a)\)
Fig. 2.40: I.R. Spectra of \(4,5\)-dihydro-5-(4-hydroxyphenyl)-3-\{(2-[2,3-diphenylquinoxalin-6-yl]methyl)-6H-indolo[2,3-b]quinoxalin-6-yl\}methyl|pyrazol-1-yl|4-hydroxy phenyl methanone (2.13b)
Fig. 2.41: $^1$H N.M.R. Spectra of \(\{4,5\text{-dihydro-5-[4-hydroxyphenyl]-3-}((2-\{2,3\text{-diphenylquinoxalin-6-yl}\text{-methyl}\}-6\text{-H-indolo[2,3-b]quinoxalin-6-yl]}\text{methyl}\text{pyrazol-1-yl}[4\text{-hydroxy phenyl]}\text{methanone (2.13b)}\)
Fig 2.42: Mass Spectra of (4,5-dihydro-5-{4-hydroxyphenyl}-3-[[2-(2,3-diphenylquinazalin-6-yl)methyl]-6H-indolo[2,3-b]quinazalin-6-yl] methyl)pyrazol-1-yl)(4-hydroxy phenyl) methanone (2.13b)
Fig: 2.43: I.R. Spectra of [5-(4-fluorophenyl)-4,5-dihydro-3-[(2-(3,3-diphenylquinoxalin-6-yl) methyl]-6H-indolo[2,3-b]quinazolin-6-yl methyl]pyrazol-1-yl][4-hydroxy phenyl] methanone (2.13c)
Fig 2.44: $^1H$ N.M.R. Spectra of (5-{4-fluorophenyl}-4,5-dihydro-3-[(2-[2,3-diphenylquinazolin-6-yl)methyl]-6H-indolo [2,3-b]quinazolin-6-yl)]methyl]pyrazol-1-yl)[4-hydroxy phenyl] methanone (2.13c)
Fig. 2.45: Mass Spectra of (5-[(4-fluorophenyl)-4,5-dihydro-3-[(2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinolin-6-yl)methyl]pyrazol-1-yl][4-hydroxy phenyl] methanone (2.13c)
Fig 2.46: LR. Spectra of 5-(4-chlorophenyl)-4,5-dihydro-3-((2-(2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)methyl]pyrazol-1-yl)(4-hydroxyphenyl)methanone (2.13d)
Fig. 2.47: $^1$H NMR spectra of (5-(4-chlorophenyl)-4,5-dihydro-3-[[2-(2,3-diphenylquinazolin-6-y1)methyl]-6H-indolo[2,3-b]quinazalin-6-yl] methyl) pyrazol-1-yl[[4-hydroxyphenyl] methanone (2.13d)
Fig 2.48: Mass Spectra of (5-(4-chlorophenyl)-4,5-dihydro-3-((2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl)methyl)pyrazol-1-yl)(4-hydroxyphenyl) methanone (2.13d)
Fig. 2.49: I.R. Spectra of (4,5-dihydro -5-(4-methoxyphenyl) -3-[[2-[(2,3-diphenylquinoxalin -6-yl) methyl]-6H-indolo[2,3-b]quinoxalin-6-yl] methyl]pyrazol-1-yl] (4-hydroxyphenyl) methanone (2.13e)
Fig 2.50: $^1$H N.M.R. Spectra of \(4,5\)-dihydro-5-(4-methoxyphenyl)-3-((2,3-diphenylquinazolin-6-yl)methyl)-6H-indolo[2,3-b]quinolin-6-yl methyl)pyrazol-1-yl\) [4-hydroxyphenyl] methanone (2.13c)
Fig. 2.51: Mass Spectra of (4,5-dihydro-5-(4-methoxyphenyl)-3-[(2-{2,3-diphenylquinolin-6-yl}methyl)-6H-indolo[2,3-b]quinolin-6-yl]methyl)pyrazol-1-yl) (4-hydroxyphenyl) methanone (2.13e)
Fig 2.19: L.R. Spectra of (4-chlorophenyl) (4,5-dihydro-5-phenyl-3-((2-(2,3-diphenyl quinoxalin-5-yl)methyl)-6H-indolo[2,3-b]quinoxalin-3-yl)methyl) pyrazol-1-yl) methanone (2.14a)
Fig. 2.20: $^1$H N.M.R. Spectra of (4-chlorophenyl) (4,5-dihydro-5-phenyl-3- [(2-[(2,3-diphenyl quinoxalin -6-yl)methyl]-6H-indolo [2,3-b]quinoxalin-6-yl)methyl] pyrazol -1-yl) methanone (2.14a)
Fig. 2.11: Mass Spectra of (4-chlorophenyl) (4,5-dihydro-5-phenyl-3-((2-((2,3-diphenyl quinoxalin -6-yl)methyl)-6H-indolo [2,3-b]quinolin-6-yl)methyl) pyrazol -1-yl) methanone (2.14a)
Fig. 3: FTIR Spectra of (4-chlorophenyl)[4,5-dihydro-5-(4-hydroxyphenyl)-3-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl]methyl) pyrazol-1-yl)methaneone (2.14b)
Fig. 2.56: $^1$H N.M.R. Spectra of (4-chloro phenyl)[4,5-dihydro-5-(4-hydroxyphenyl)-3-[(2-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b]quinoxalin-6-yl] methyl) pyrazol-1-yl]methanone (2.14b)
Fig-2.57: Mass Spectra of (4-chloro phenyl) (4,5-dihydro-5-(4-hydroxyphenyl)-3-((2-((2,3-diphenylquinoxalin-6-yl)methyl)-6H-indolo[2,3-b]quinoxalin-6-yl) methyl) pyrazol-1-yl) methanone (2.14b)
Fig-2.58: L.R. Spectra of (4-chlorophenyl)-[5-{4-fluorophenyl}-4,5-dihydro-3-[(2,3-diphenylquinoxalin-6-yl)methyl]-6H-indolo[2,3-b] quinoxalin-6-yl[methyl] pyrazol-1-yl] methanone (2.14c)
Fig. 2.59: \(^1\)H N.M.R. Spectra of \([4\mathrm{-chlorophenyl}][5\mathrm{-fluorophenyl}]4,5\mathrm{-dihydro}-3\{2\{[2,3\mathrm{-diphenylquinazolin-6-yl}methyl]-6\mathrm{-H-indolo[2,3-b]}\mathrm{quinazolin-6-yl}methyl\}\mathrm{pyrazol-1-yl}\}\) methanone (2.14c)
Fig 2.60: Mass Spectra of [4-chlorophenyl][5-(4-fluorophenyl)-4,5-dihydro-3-[[2,3-$\text{diphenyl} \text{quinazolin-6-yl}]$-$\text{methyl}$$]$-$6\text{H}$-$\text{indolo}[2,3-b] \text{quinoxalin-6-yl}]$-$\text{methyl}$$]$-$\text{pyrazol-1-yl}$ methanone (2.14c)
Fig 2.61: LR Spectra of (4-chlorophenyl)[5-(4-chlorophenyl)-4,5-dihydro-3-(2-(2,3-diphenyl quinoxaline-6-yl)methyl)-6H-indolo [2,3-b] quinoxaline-6-ylmethyl] pyrazol-1-yl] methanone (2.14d)
Fig-2.62: 'H N.M.R. Spectra of (4-chlorophenyl)[5-(4-chlorophenyl)-4,5-dihydro-3-[[2-(2,3-diphenyl quinoxalin-6-yl)methyl]-6H-indolo[2,3-b] quinoxalin-6-yl)methyl] pyrazol-1-yl] methanone (2.14d)
Fig. 2.63: Mass Spectra of \((4\text{-chlorophenyl})(5\text{-}4\text{-chlorophenyl})\text{-4,5-dihydro-3-[(2,3-diphenyl quinoxalin-6-yl)methyl]-6H-indolo [2,3-b] quinoxalin-6-yl]methyl} \text{pyrazol-1-yl} \text{methane} \text{one} \,(2.14d)\)
Fig-2.64: I.R. Spectra of (4-chlorophenyl)-(4,5-dihydro-5-(4-methoxyphenyl)-3-[(2-(2,3-diphenylquinolin-6-yl)methyl]-6H-indolo [2,3-b] quinoxalin-6-yl) methyl) pyrazol-1-yl) methanone (2.14e)
Fig 2.65: $^1$H N.M.R. Spectra of (4-chlorophenyl)(4,5-dihydro-5-(4-methoxyphenyl)-3-[(2,3-diphenylquinazolin-6-yl)methyl]-6H-indolo [2,3-b] quinoxalin-5-yl) methyl pyrazol-1-yl) methanone (2.14e)
Fig. 2.66: Mass Spectra of \([4\text{-}chlorophenyl][4,5\text{-}dihydro\text{-}5\text{-}(4\text{-}methoxyphenyl)\text{-}3\text{-}((2\text{-}[(2,3\text{-}diphenylquinazolin-6\text{-}yl)\text{-}methyl]\text{-}6H\text{-}indol} [2,3\text{-}b]\text{ quinoxalin-6\text{-}yl}\text{-}methyl\text{ pyrazol-1\text{-}yl}]\text{-}methanone (2.14e)
Scheme – 2.7

(2.11a) → (2.11b) → (2.11c) 

(2.11b) HN - O - HO - C - NHNNH₂ → Glacial acetic acid → (2.11c) 

(2.13a) H₂N - N - N - N - O - OH → (2.13c) 

(2.13a) H₂N - N - N - N - O - OH → (2.13b) 

(2.13b) H₂N - N - N - N - O - OH → (2.13d) 

(2.13d) H₂N - N - N - N - O - OH → (2.13e) 

(2.13e) H₂N - N - N - N - O - OH → Glacial acetic acid → (2.11d) 

(2.11d) H₂N - N - N - N - O - OH → (2.11e) 

(2.11e) H₂N - N - N - N - O - OH →
2.4 Experimental Section

1. General procedure for the synthesis of (2.6): 0.01 M (2.10 g) of benzil was added to 0.01 M (1.08 g) of o-phenylenediamine and they were subjected to reflux with 15 ml of ethanol for 30 min. After filtration the product (2.6) was subjected to drying and then recrystallization was done using absolute alcohol.

2. General procedure for the synthesis of (2.8): 0.01 M (1.47 g) of Isatin was added to 0.01 M (1.08 g) of o-phenylenediamine and they were subjected to reflux with 15 ml of ethanol for 30 min. After filtration the product (2.8) was subjected to drying and then recrystallization was done using absolute alcohol.

3. General procedure for the synthesis of (2.9): A mixture of 0.01 M (2.82 g) of 6H-Indolo[2,3-b] quinoxalin (2.8) and 0.01 M (2.17 g) of 2,3-diphenyl quinoxaline (2.6) were taken in 120 ml of water and 25 ml of 35% HCl at 50°C. To this 35 parts formaldehyde solution was added and stirred for 4 hr at 70°C using magnetic stirrer. The product (2.9) was neutralized using NH₃ solution, filtered and dried. The produced crude product (2.9) is recrystallized with hot acetic acid. Thin Layer Chromatography and melting point methods were used to check the purity. (Table - 2.1).

4. General procedure for the synthesis of (2.10): A mixture of 150 ml of dry acetone and 30 g of anhydrous potassium carbonate were taken in the
250ml round bottom flask. Added to it 0.01M (5.13g) of (2.9) and 0.01 M (0.092 g) of chloro acetone and the mixture was refluxed at 75°C for about 6 hr, the product (2.10) was recrystallized using acetone. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.1).

5. General procedure for the synthesis of (2.11a): A solution of NaOH/KOH (8ml, 10% in water) was added drop-wise to a well stirred solution of 0.01M (5.69 g) of (2.10) and 0.01M (1.06 g) of benzaldehyde in 20ml ethanol at cold temperature. This mixture was allowed for stirring for about 24hr in cold condition using ice bath and then diluted with ice water following acidification with Conc.HCl. The product was then filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.1).

6. General procedure for the synthesis of (2.11b): A solution of NaOH/KOH (8ml, 10% in water) was added drop-wise to a well stirred solution of 0.01M (5.69 g) of (2.10) and 0.01M (1.22 g) of p-hydroxy benzaldehyde in 20ml ethanol at cold temperature. This mixture was allowed for stirring for about 24hr in cold condition using ice bath and then diluted with ice water following acidification with Conc.HCl. The product was then filtered, dried and recrystallization was done using aqueous
ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. \textit{(Table-2.1)}.

7. \textbf{General procedure for the synthesis of (2.11c):} A solution of NaOH/KOH (8ml, 10% in water) was added drop wise to a well stirred solution of 0.01M (5.69 g) of \textit{(2.10)} and 0.01M (1.56 g) of \textit{p-chloro benzaldehyde} in 20ml ethanol at cold temperature. This mixture was allowed for stirring for about 24hr in cold condition using ice bath and then diluted with ice water following acidification with Conc.HCl. The product was then filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. \textit{(Table-2.1)}.

8. \textbf{General procedure for the synthesis of (2.11d):} A solution of NaOH/KOH (8ml, 10% in water) was added drop-wise to a well stirred solution of 0.01M (5.69 g) of \textit{(2.10)} and 0.01M (1.24 g) of \textit{p-fluoro benzaldehyde} in 20ml ethanol at cold temperature. This mixture was allowed for stirring for about 24hr in cold condition using ice bath and then diluted with ice water following acidification with Conc.HCl. The product was then filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. \textit{(Table-2.1)}.
9. General procedure for the synthesis of (2.11e): A solution of NaOH/KOH (8ml, 10% in water) was added drop-wise to a well stirred solution of 0.01M (5.69 g) of (2.10) and 0.01M (1.36 g) of p-methoxy benzaldehyde in 20ml ethanol at cold temperature. This mixture was allowed for stirring for about 24hr in cold condition using ice bath and then diluted with ice water following acidification with Conc.HCl. The product was then filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.1).

10. General procedure for the synthesis of (2.12a): 0.01M (6.57g) of (2.11a) and 0.02M (2.72g) of benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.2).

11. General procedure for the synthesis of (2.12b): 0.01M (6.73g) of (2.11b) and 0.02M (2.72g) of benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer
Chromatography and melting point methods were used to check the purity.

(Table-2.2).

12. **General procedure for the synthesis of (2.12c):** 0.01M (6.75g) of (2.11c) and 0.02M (2.72g) of benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130\(^0\)C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.2).

13. **General procedure for the synthesis of (2.12d):** 0.01M (6.92g) of (2.11d) and 0.02M (2.72g) of benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130\(^0\)C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.2).

14. **General procedure for the synthesis of (2.12e):** 0.01M (6.87g) of (2.11e) and 0.02M (2.72g) of benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130\(^0\)C, treated the above
reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

15. **General procedure for the synthesis of (2.13a):** 0.01M (6.57g) of *(2.11a)* and 0.02M (3.04g) of p-hydroxy benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130\(^0\)C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

16. **General procedure for the synthesis of (2.13b):** 0.01M (6.73g) of *(2.11b)* and 0.02M (3.04g) of p-hydroxy benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130\(^0\)C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

17. **General procedure for the synthesis of (2.13c);** 0.01M (6.75g) of *(2.11c)* and 0.02M (3.04g) of p-hydroxy benzoic acid hydrazide were taken
in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

18. **General procedure for the synthesis of (2.13d):** 0.01M (6.92 g) of *(2.11d)* and 0.02M (3.04g) of *p*-hydroxy benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

19. **General procedure for the synthesis of (2.13e):** 0.01M (6.87 g) of *(2.11e)* and 0.02M (3.04g) of *p*-hydroxy benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*
20. **General procedure for the synthesis of (2.14a):** 0.01M (6.57 g) of (2.11a) and 0.02M (3.40 g) of p-chloro benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

21. **General procedure for the synthesis of (2.14b):** 0.01M (6.73 g) of (2.11b) and 0.02M (3.40 g) of p-chloro benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. *(Table-2.2).*

22. **General procedure for the synthesis of (2.14c):** 0.01M (6.75 g) of (2.11c) and 0.02M (3.40 g) of p-chloro benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer
Chromatography and melting point methods were used to check the purity. (Table-2.2).

23. General procedure for the synthesis of (2.14d): 0.01M (6.92 g) of (2.11d) and 0.02M (3.40 g) of p-chloro benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.2).

24. General procedure for the synthesis of (2.14e): 0.01M (6.87 g) of (2.11e) and 0.02M (3.40g) of p-chloro benzoic acid hydrazide were taken in 20ml glacial acetic acid and refluxed for 10 hr above 130°C, treated the above reaction mixture cold water. Product was filtered, dried and recrystallization was done using aqueous ethanol. Thin Layer Chromatography and melting point methods were used to check the purity. (Table-2.2).
Table-2.1 Physical data of Indolo Quinoxaline compounds (2.9), (2.10), 2.11(a-e).

<table>
<thead>
<tr>
<th>S.No</th>
<th>Starting material used</th>
<th>Reactant used</th>
<th>Product obtained</th>
<th>Molecular formula</th>
<th>M.P (°C)</th>
<th>Yield (%)</th>
<th>Rf value</th>
</tr>
</thead>
<tbody>
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<td>2.6, 2.8</td>
<td>35%HCl, HCHO</td>
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<td>C_{35}H_{23}N_{5}</td>
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<td>Chloro acetone</td>
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<td>60</td>
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<tr>
<td>3.</td>
<td>2.10</td>
<td>Benzaldehyde</td>
<td>2.11a</td>
<td>C_{45}H_{31}N_{5}O</td>
<td>112-114</td>
<td>73</td>
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<td>p-hydroxy benzaldehyde</td>
<td>2.11b</td>
<td>C_{45}H_{31}N_{5}O</td>
<td>113-115</td>
<td>77</td>
<td>0.89</td>
</tr>
<tr>
<td>5.</td>
<td>2.10</td>
<td>p-fluoro benzaldehyde</td>
<td>2.11c</td>
<td>C_{45}H_{30}F_{N}O</td>
<td>118-120</td>
<td>76</td>
<td>0.88</td>
</tr>
<tr>
<td>6.</td>
<td>2.10</td>
<td>p-chloro benzaldehyde</td>
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### Table-2.2 Physical data of Pyrazolo indolo quinoxaline compounds 2.12 (a-e), 2.13(a-e) and 2.14(a-e)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Starting material used</th>
<th>Reactant used</th>
<th>Product obtained</th>
<th>Molecular formula</th>
<th>M.P (°C)</th>
<th>Yield (%)</th>
<th>Rf value</th>
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<td>C\textsubscript{52}H\textsubscript{37}N\textsubscript{7}O</td>
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<tr>
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<td>2.13b</td>
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<td>p-hydroxy Benzoic acid hydrazide</td>
<td>2.13c</td>
<td>C\textsubscript{52}H\textsubscript{36}FN\textsubscript{7}O\textsubscript{2}</td>
<td>158-160</td>
<td>67</td>
<td>0.8</td>
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<tr>
<td>9.</td>
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<td>p-hydroxy Benzoic acid hydrazide</td>
<td>2.13d</td>
<td>C\textsubscript{52}H\textsubscript{36}ClN\textsubscript{7}O\textsubscript{2}</td>
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<td>2.13e</td>
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<td>14.</td>
<td>2.11d</td>
<td>p-chloro Benzoic acid hydrazide</td>
<td>2.14d</td>
<td>C\textsubscript{52}H\textsubscript{35}Cl\textsubscript{2}N\textsubscript{7}O</td>
<td>160-163</td>
<td>66</td>
<td>0.89</td>
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<tr>
<td>15.</td>
<td>2.11e</td>
<td>p-chloro Benzoic acid hydrazide</td>
<td>2.14e</td>
<td>C\textsubscript{53}H\textsubscript{38}ClN\textsubscript{7}O\textsubscript{2}</td>
<td>120-123</td>
<td>62</td>
<td>0.75</td>
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### Table- 2.3 Spectral data of Indolo Quinoxaline compounds 2.11(a-e)

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<th>Mass (m/z value)</th>
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<tbody>
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<td>1</td>
<td>2.11a</td>
<td>1712 (C=O Str, chalcone), 1675 (C=N Str, quinoxaline) 1600-1620 (C=C Str, chalcone), 1343 (C-H Str, methylene), 3056-3020 (Ar-H Str) as diagnostic absorptions</td>
<td>7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.82 (s, 2H, -CH(_2)-), 7.30-7.50 (m, 15 H, benzene), 5.50 (s, 2H, -CH(_2)-CO-)</td>
<td>657.6</td>
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<td>2</td>
<td>2.11b</td>
<td>3670 (broad O-H str, phenolic), 1122 (C-O Str, phenolic), 1712 (C=O str, chalcone), 1600-1620 (C=C Str, chalcone), 3056-3020 (Ar-H Str) as diagnostic absorptions</td>
<td>7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 (s, 2H, -CH(_2)-), 7.30-7.49 (m, 10 H, benzene), 5.00 (s, 1H, O-H), 5.50 (s, 2H, -CH(_2)-CO-), 6.6, 7.5 (d, 2H, ethylene)</td>
<td>673.6</td>
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<tr>
<td>3</td>
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<td>696.04 (Ar-F Str), 1712 (C=O Str, chalcone), 1600-1620 (C=C Str, chalcone), 3056-3020 (Ar-H Str) as diagnostic absorptions</td>
<td>7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.95 (m, 6H, quinoxaline), 3.81 (s, 2H, -CH(_2)-), 7.30-7.48 (m, 10 H, benzene), 5.50 (s, 2H, -CH(_2)-CO-), 6.90, 7.50 (d, 2H, ethylene), 6.90-7.20 (m, 4H, *CH(_4)-OH)</td>
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<td>767.08 (Ar-Cl Str), 1712 (C=O Str, chalcone), 1600-1620 (C=C Str, chalcone), 3056-3020 (Ar-H Str) as diagnostic absorptions</td>
<td>7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.95 (m, 6H, quinoxaline), 3.81 (s, 2H, -CH(_2)-), 7.20-7.49 (m, 10 H, benzene), 5.50 (s, 2H, -CH(_2)-CO-), 6.90, 7.50 (d, 2H, ethylene), 7.22-7.25 (m, 4H, *CH(_4)-Cl)</td>
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<td>2.11e</td>
<td>1045 (C-O-C Str, phenyl methoxy), 1712 (C=O str, chalcone), 1600-1620 (C=C Str, chalcone), 3056-3020 (Ar-H Str) as diagnostic absorptions</td>
<td>7.10 (m, 4H, C-H indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 (s, 2H, -CH(_2)-), 7.20-7.50 (m, 10 H, benzene), 5.50 (s, 2H, -CH(_2)-CO-), 6.60, 7.50 (d, 2H, ethylene), 3.70 (O-*CH(_3)), 6.70-7.20 (m, 4H, *CH(_4)-OCH(_3))</td>
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### Table 2.4. Spectral data of pyrazolo Indolo quinoxaline derivatives 2.12(a-e)

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<td>3030 (Ar-H Str.), 1340 (C-N Str), 1675 (C=N Str), 2945 (N-H, Str), 1704 (C=0 Str) as diagnostic absorptions.</td>
<td>7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -CH₂-C-), 7.00-7.90 (m, 20 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂*-CH-C), 2.00, 1.80 (d, 2H, -C*-CH₂-C-)</td>
<td>775.5</td>
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<td>2.12b</td>
<td>3429 (Broad O-H Str), 1241 (C-OH Str), 3030 (Ar-H Str.), 1340 (C-N Str), 1675 (C=N Str), 3350 (N-H, Str), 1704 (C=0 Str) as diagnostic absorptions.</td>
<td>5.00 (s, 1H, -OH), 6.50-7.90 (m, 4H, -C₆H₄-OH) 7.13 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 (s, 2H, -CH₂-C-), 7.00-7.90 (m, 15 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂*-CH-C), 2.00, 1.80 (d, 2H, -C*-CH₂-C-)</td>
<td>791.7</td>
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<td>2.12c</td>
<td>3010 (Ar-H Str.), 1340 (C-N Str), 1685 (C=N Str), 2985 (N-H, Str), 1700 (C=0 Str) 769 (C-F Str) as diagnostic absorptions.</td>
<td>6.90-7.90 (m, 4H, -C₆H₄-F), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 (s, 2H, -CH₂-C-), 7.10-7.95 (m, 15 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂*-CH-C), 2.00, 1.80 (d, 2H, -C*-CH₂-C-)</td>
<td>793.7</td>
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<tr>
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<td>2.12d</td>
<td>3027 (Ar-H Str.), 1340 (C-N Str), 1685 (C=N Str), 2955 (N-H, Str), 1700 (C=0 Str), 610 (C-Cl Str) as diagnostic absorptions.</td>
<td>7.00-7.90 (m, 4H, -C₆H₄-Cl), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -CH₂-C-), 7.10-7.95 (m, 15 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂*-CH-C), 2.00, 1.80 (d, 2H, -C*-CH₂-C-)</td>
<td>809.7</td>
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<tr>
<td>5</td>
<td>2.12e</td>
<td>1044 (C-O-C Str), 1340 (C-N Str), 1663 (C=N Str), 2975 (N-H, Str), 1700 (C=0 Str), as diagnostic absorptions.</td>
<td>3.70 (s, 3H, -O-CH₃), 6.70-7.90 (m, 4H, -C₆H₄-OCH₃), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -CH₂-C-), 7.00-7.95 (m, 15 H, phenyl), 3.9 (s, 2H, -N-CH₂-C-), 4.9 (t, 1H, -CH₂*-CH-C), 2.00, 1.80 (d, 2H, -C*-CH₂-C-)</td>
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<td>--------------------------------------</td>
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<td>2.13a 3429 (Broad O-H Str), 3033 (Ar-H Str), 1340 (C-N Str), 1645 (C=N Str), 2955 (N-H, Str), 1700 (C=O Str), as diagnostic absorptions.</td>
<td>5.00 (s, 1H, -OH), 6.90-7.70 (m, 4H, -C(_6)H(_4)-OH ) 7.10 (m, 4H, C-H Indolo quinoxaline),7.40-7.90 (m, 6H, quinoxaline), 3.80 ( s, 2H, -C*CH2-C-), 6.90-7.48 (m, 15 H, phenyl ), 3.9 (s, 2H, -N-CH2-C-), 4.9(t, 1H, -CH2-*CH-C),2.00,1.80(d,2H, -C-*CH2-C-).</td>
<td>791.2</td>
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<td>2.13b 3382 (Broad O-H Str), 3037 (Ar-H Str), 1340 (C-N Str), 1677 (C=N Str), 2949 (N-H, Str), 1700 (C=O Str), as diagnostic absorptions.</td>
<td>5.00, 5.11 (s, 2H, -OH), 6.60-7.70 (m, 8H, -C(_6)H(_4)-OH ) 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 ( s, 2H, -C*CH2-C-), 7.20-7.50 (m, 10 H, phenyl ), 3.9(s,2H,-N-CH2-C-),4.9 (t, 1H, -CH2-*CH-C),2.00,1.80(d, 2H, -C-*CH2-C-).</td>
<td>807.0</td>
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<td>2.13c 768 (C-F Str) 3387 (Broad O-H Str), 3036 (Ar-H Str), 1340 (C-N Str), 1675 (C=N Str), 2945 (C-H, Str), as diagnostic absorptions.</td>
<td>5.00 (s, 1H, -OH), 6.9-7.7(m, 4H, -C(_6)H(_4)-F)6.9-7.80(m, 4H,-C(_6)H(_4)-OH),7.10 (m,4H,C-H Indoloquinoxaline) , 7.40-7.90 (m, 6H, quinoxaline),3.80 ( s, 2H, -C*CH2-C-),7.20-7.50 (m, 10 H, phenyl ),3.9(s,2H,-N-CH2-C-),4.9(t,1H,-CH2-*CH-C),2.00,1.80(d,2H,-C-*CH2-C-).</td>
<td>809.0</td>
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</tr>
<tr>
<td>4</td>
<td>2.13d 697 (C-Cl Str) 3389 (Broad O-H Str), 3024 (Ar-H Str), 1340 (C-N Str), 1675 (C=N Str), 2945 (N-H, Str), 1700 (C=O Str), as diagnostic absorptions.</td>
<td>5.00 (s, 1H, -OH), 6.90-7.70 (m, 4H, -C(_6)H(_4)-Cl ) 6.90-7.70 (m, 4H, -C(_6)H(_4)-OH ) 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.80 ( s, 2H, -C*CH2-C-),7.20-7.50 (m, 10 H, phenyl ), 3.9 (s, 2H, -N-CH2-C-), 4.9 (t, 1H, -CH2-*CH-C),2.00,1.80(d, 2H, -C-*CH2-C-).</td>
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<td>2.13e 1045 (C-O-C Str) 3387 (Broad O-H Str),3030 (Ar-H Str), 1340 (C-N Str), 1675 (C=N Str), 2945 (N-H, Str), 1700 (C=O Str), as diagnostic absorptions.</td>
<td>3.7 (s, 3H,-OCH3),5.00 (s, 1H, -OH),6.90-7.70 (m, 4H,-C(_6)H(_4)-OCH3) 6.70-7.70 (m, 4H,-C(_6)H(_4)-OH ), 7.10 (m, 4H, C-H Indolo quinoxaline),7.40-7.90(m, 6H, quinoxaline), 3.80 ( s, 2H, -C*CH2-C-),7.20-7.50(m,10 H, phenyl), 3.9(s,2H,-N-CH2-C-),4.9(t,1H,-CH2-*CH-C), 2.00, 1.80 (d,2H,-C-*CH2-C-).</td>
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### Table 2.6. Spectral data of pyrazolo Indolo quinoxaline derivatives 2.14(a-e)

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<th>Mass (m/z value)</th>
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<td>1</td>
<td>2.14a</td>
<td>697 (C-Cl Str), 3028 (Ar-H Str,), 1340 (C-N Str), 1678 (C=N Str), 2925 (N-H, Str), 1700 (C=0 Str), as diagnostic absorptions.</td>
<td>7.12-7.89 (m, 4H, *C(_6)H(_4)-Cl), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -C=CH(_2)-C-), 7.00-7.90 (m, 15 H, phenyl ), 3.9 (s, 2H, -N-CH(_2)-C-), 4.9 (t, 1H, -CH(_2)-CH-C), 2.00,1.80 (d, 2H, -C-H(_2)-C-).</td>
<td>809.0</td>
</tr>
<tr>
<td>2</td>
<td>2.14b</td>
<td>697 (C-Cl Str), 3429 (Broad O-H Str), 3037 (Ar-H Str,), 1340 (C-N Str), 1679 (C=N Str), 2948 (N-H, Str), 1700 (C=0 Str), as diagnostic absorptions.</td>
<td>6.60-7.90 (m, 4H, *C(_6)H(_4)-Cl), 6.60-7.90 (m, 4H, -C(_6)H(_4)-OH), 5.00(s,1H,-OH),7.17(m,4H,C-H Indolo quinoxaline ),7.40-7.90 (m, 6H, quinoxaline),3.81(s,2H,-C(_2)-C-), 7.20-7.60 (m, 10 H, phenyl ),3.9 (s, 2H, -N-CH(_2)-C-),4.9(t,1H,-CH(_2)-CH-C),2.0,1.80 (d, 2H, -C-H(_2)-C-).</td>
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<td>697 (C-Cl Str), 728 (C-F Str), 3072 (Ar-H Str,), 1340 (C-N Str), 1677 (C=N Str), 2946 (N-H, Str), 1700 (C=0 Str), as diagnostic absorptions.</td>
<td>7.30-7.90 (m, 4H, *C(_6)H(_4)-Cl), 6.90-7.70 (m, 4H, -C(_6)H(_4)-F), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -C(_2)-CH(_2)-C-), 7.20-7.50 (m, 10 H, phenyl ), 3.9 (s, 2H, -N-CH(_2)-C-), 4.9 (t, 1H, -CH(_2)-CH-C), 2.00,1.80 (d, 2H, -C(_2)-C-).</td>
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<td>7.00-7.90 (m, 8H, *C(_6)H(_4)-Cl), 7.10 (m, 4H, C-H Indolo quinoxaline), 7.40-7.90 (m, 6H, quinoxaline), 3.81 (s, 2H, -C(_2)-CH(_2)-C-), 7.20-7.50 (m, 10 H, phenyl ), 3.9 (s, 2H, -N-CH(_2)-C-), 4.9 (t, 1H, -CH(_2)-CH-C), 2.00,1.80 (d, 2H, -C(_2)-C-).</td>
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<td>1045 (C-O-C Str) 697 (C-Cl Str), 3039 (Ar-H Str,) 1340 (C-N Str), 1676 (C=N Str), 2935 (N-H, Str), 1700 (C=0 Str), as diagnostic absorptions.</td>
<td>3.72 (s, 3H, -CH(_3)), 6.70-7.90 (m, 4H, C(_6)H(_4)-OCH(_3)), 6.70-7.80 (m, 4H, *C(_6)H(_4)-Cl), 7.10 (m, 4H, C-H Indolo quinoxaline),7.40-7.90(m,6H,quinoxaline),3.81(s,2H,-C(_2)-CH(_2)-C-), 7.20-7.50 (m, 10 H, phenyl ),3.9( s, 2H, -N-CH(_2)-C-),4.9(t,1H,-CH(_2)-CH-C),2.00,1.80 (d, 2H, -C(_2)-C-).</td>
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### Table-2.7. IUPAC names of pyrazolo Indoloquinoxaline derivatives

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2.5 Conclusions:

An attempt has been made to synthesize new quinoxaline compounds which contain indolo quinoxaline and pyrazole ring systems fused with them, utilizing easily accessible chemicals in environmental friendly and mild conditions in high yields and purities. I.R, $^1$HNMR and mass spectral data was used for the structural characterization of all the newly synthesized pyrazolo indoloquinoxaline compounds. The methods achieved are valid and viable.
2.6 References:


13. R. Suthakaran, G. Nagarajan, V. Balasubramaniam, K. Suganthi and G. Velraj, Synthesis and antimicrobial activity of 8-(methylene-2”,3”-disubstituted benzo quinazolo - 4” -one) -
9,2- (4’)-di substituted benzo pyrano pyrazoles Ind. J. Hetero. Chem, 14, 2005, 201.


