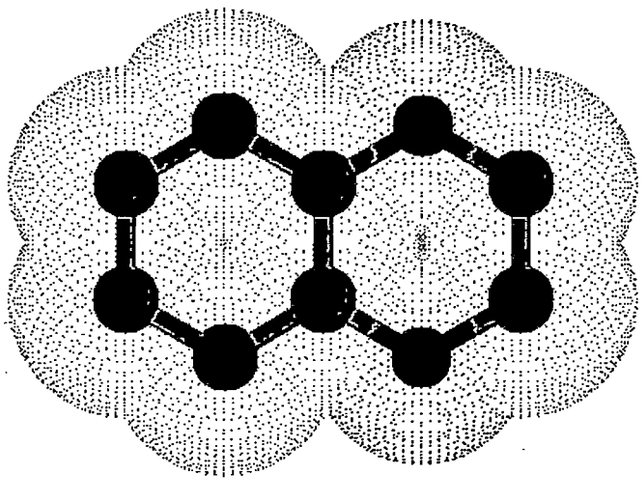
CHAPTER I

Introduction



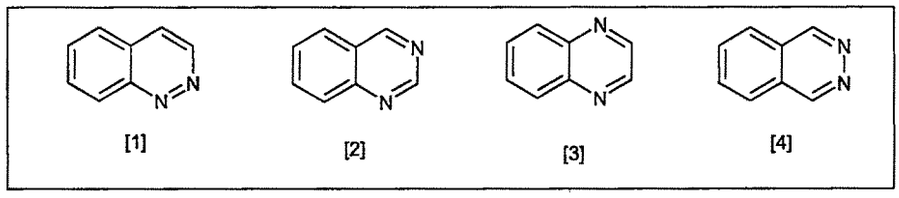
Quinoxaline

1.1 Introduction

Heterocyclic compounds are very widely distributed in nature and are essential for life activities. They play a vital role in the metabolism of all living cells, for example the vitamins and co-enzyme precursors thiamine, riboflavin etc. Some of these are natural products for example antibiotics such as penicillin and cephalosporin etc. However, the large majority are synthetic heterocycles, which have found widespread use as anticancer agents, analeptics, analgesics, and hypnotics and as pesticides, insecticides, weedicides and rodenticides. There are large number of synthetic heterocyclic compounds having practical applications as dye-stuffs, co-polymers, solvents, photographic sensitizers and developers, as antioxidants and vulcanization accelerators in the rubber industry and many of them are valuable intermediates in synthesis.

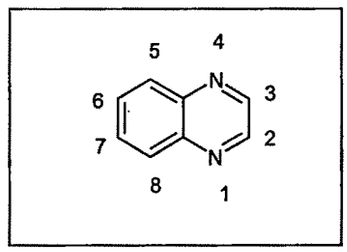
An enormous number of heterocyclic compounds are known and this number is increasing very rapidly. Nearly six million compounds are recorded in chemical abstract and approximately half of these are heterocycles. Among these **quinoxaline** is one of the interesting class of heterocyclic compound having wide range of application in medicinal and synthetic chemistry. These compounds exhibit varieties of biological activities such anti-cancer, anti-malerial, anti-inflammatory, anti-bacterial etc. The benzocondensed heterocycles containing two nitrogen atoms have four isomers,

1) Cinnoline (1,2 benzodiazine) [1]
2) Quinazoline (1,3 benzodiazine) [2]
3) Quinoxaline (1,4 benzodiazine) [3]
4) Phthalazine (2,3 benzodiazine) [4]



In the present thesis, we have reported some new derivatives of quinoxaline nucleus also called as 1,4-benzodiazine or benzopyrazines. The quinoxalines are formed by the spontaneous reaction of aromatic diamines with 1,2-dicarbonyl compounds by Korner[1] and by Hinsberg [2] synthesis independently.

The numbering system universally used for quinoxaline is shown in the formula



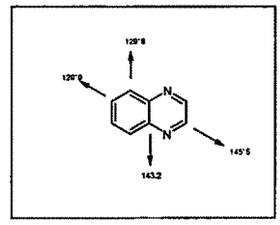
Physical Properties:

1) The physical properties of the quinoxalines are in general quite similar to those of the pyrazines. Quinoxaline melts at 31^0C and its lower homologs are liquids or low melting solids. The parent compound is miscible with water in all proportions[3]
2) **Behavior as Tertiary amine:** Quinoxaline like pyrazine is a very weak base.[4]
3) **Ionization property:** The ionization constant (thermodynamic constant) of quinoxaline is 0.72.[5]

4) The ultraviolet absorption spectrum of quinoxaline in cyclohexane shows bands at 340, 312, 232 mμ and which are attributable to η-π* and π-π* transitions.[6]

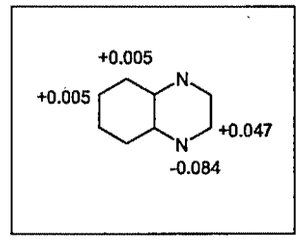
5) **Infrared absorption spectra:** The low frequency bands for quinoxaline and for its derivatives have been observed.[7] The intensity of the band near 1600 cm^{-1} observed for 2,5,6-monosubstituted quinoxaline.

6) **^{13}C NMR of the quinoxaline:** Total 4 peaks observed.[8]



6) The synthesis and mass spectral fragmentation of several new Aryloxy-methylquinoxalines, benzo [b]-and naphtha [2,1-b]-furylquinoxalines were studied by Ines Starke and co-workers.[9]

8) The electron density diagram of quinoxaline as below.[10]



9) The pka of quinoxaline 0.6 because insertion of second ring nitrogen atom lowers the basic strength. (Cinnoline = 3.2, Phthalazine = 3.5).

10) The oxidation-reduction potential of quinoxaline is –1.1.

General Reactions of quinoxaline:

1) **Nuclear Substitution:** Quinoxaline is resistant to nitration under mild conditions. On treatment with a mixture of oleum and nitric acid at 90°C for 24 hr it gives 1.5% of 5-nitroquinoxaline and 24% of 5,6-dinotroquinoxaline.[11] The reaction of 1,2-dihydroquinoxaline with PCl_5 gives 2,3-dichloroquinoxaline.[12]
2) **Addition to the N=C function:** Quinoxaline undergo facile addition reactions with nucleophilic reagents. The reaction of quinoxaline with allylmagnesium bromide gives after hydrolysis of the initial adduct 86% of 2,3-diallyl-1, 2,3,4-tetrahydroquinoxaline. Quinoxaline is more reactive to this nucleophile that related aza-heterocyclic compounds and the observed order of reactivity is Pyridine < Quinoline ≅ isoquinoline < phenanthridine ≅ acridine < quinoxaline.[13]
3) **Reduction:** a) Catalytic reduction of 2-acetyl-3-methylquinoxaline in ethanol with 1 mole of hydrogen gives a deep crimson solution from which red-brown needles of 2-acetyl-1,4-dihydro-3-methylquinoxaline are obtained. Ethanolic solutions of 2-acetyl-1,4-dihydro-3-methyl quinoxaline reoxidize on exposure to air for several days, Similar results are obtained with 2-acetyl-3-phenyl quinoxaline from a reduction of which a purple red dye obtained.[14]

   b) 1,2,3,4-tetrahydro derivatives are formed when either quinoxaline or 6-chloroquinoxaline is reduced with $LiAlH_4$ in etheral solution.[15]

   c) Hydrogenation of quinoxaline or 1,2,3,4-tetrahydroquinoxaline over a 5% rhodium-on-alumina catalyst at 100 °C and 136 atmospheres or over freshly prepared Raney nickel W-6 under similar conditions

gives *meso-(cis)*-decahydroquinoxaline in high yield.[16]

4) **Oxidation:** a) In the preparation of quinoxaline N-oxide, it is advantageous to use peracetic acid rather than aqueous hydrogen peroxide as the oxidizing agent. Thus treatment of quinoxaline with one equivalent of peracetic acid in acetic acid gives quinoxaline 1-oxide and with excess of per acetic acid quinoxaline 1,4-oxide is formed.[17]

b) The electrolytic oxidation of quinoxaline at a copper anode gives pyrazine-2, 3-dicraboxylic acid in an excellent yield.[18]

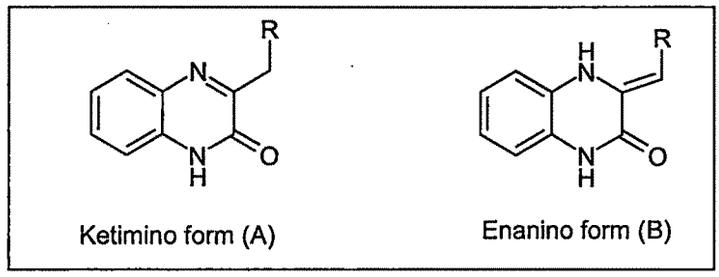
5) **Alkylation:** The methylation with methyliodide and dimethylsulphate in a alkaline medium as well as the methylation with diazomethane leads to N-methylderivatives.[19,20]

6) **Quinoxaline quaternary salts:** The formation of quinoxaline quaternary salts is often difficult. However, reaction of quinoxaline with ethyl iodide in boiling acetonitrile gives ethyl quinoxalinium iodide in 76% yield and treatment of the parent base with methyl toluene-p-sulfonate at room temperature gives methyl quinoxalinium toluene-p-sulfonate in quantitative yield.[21]

7) **Amination of NH group in position 1:** The amination of 1,2-dihydro-quinoxaline-2-one by hydroxylamine-O-sulfonic acid leads to the corresponding 1-aminoderivatives and due to the subsequent oxidation 1,2,4-benzotriazines are formed.[22]

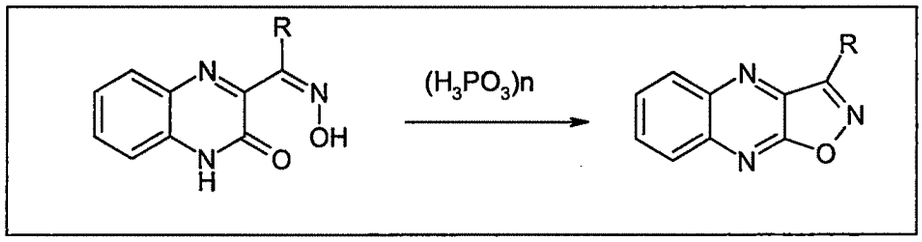
8) **The nucleophilic substitution in position 2:** As far as the nucleophilic substitution in position 2 are considered the reaction of quinoxaline-2-one with PCl_5 gives 2,3- dichloroquinoxaline.[23] Heating with phosphorus sulfide in pyridine leads to 2-thioxo-derivative.[24]

9) **The tautomerism of 3-alkyl derivatives:** The 3-alkyl-quinoxaline-2-one can exist in two ketimino (A) and enamino (B) tautomeric forms. The NMR study performed by Kunwatani and Iyoda [25,26] showed the excess of ketimino form (A) at all studied compounds. Some special cases of more stable enamino form (B) were described. Chapman [27] presented that the enamine form (B) is preferred in case of 3-alkoxyl carbonyl methyl derivatives. This form is more stable due to intramolecular hydrogen bonding.



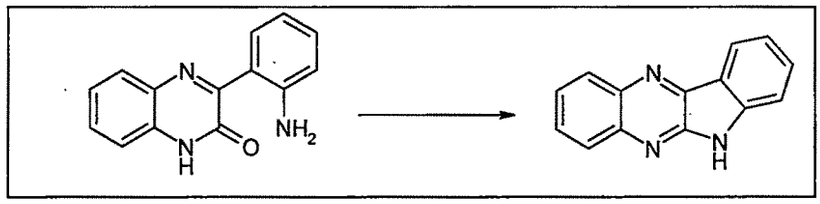
10) **The reactivity of 3-alkyl derivatives of quinoxaline-2-one:** The alkyl group in position 3 is reactive for some electrophilic agents. In case of 3-methyl derivatives both bromination [28] and oxidation [29] with SeO_2 proceeds easily.

11) **The cyclization reaction of quinoxaline-2-one:** 3-acylmethyl quinoxaline-2-one cyclize by heating with polyphosphoric acid [30]



12) **The cyclization with closure of nitrogen heterocycles:** The well known cyclization with closure of nitrogen heterocycle of 3-substituted quinoxaline-2-one is the cyclization of 3-(o-

amino phenyl)-quinoxaline-2-one. The reaction proceeds in boiling acetic or hydrochloric acid.[31]

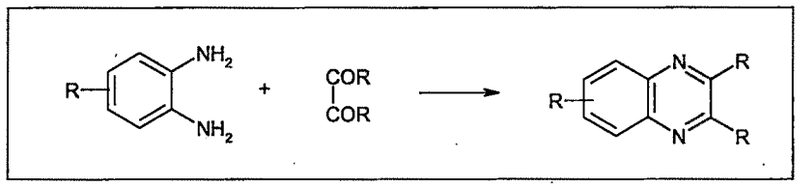


Synthesis:

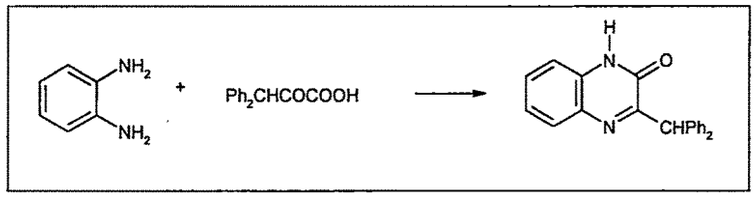
1) Preparation of quinoxalines from *o*-diamines
2) Preparation of quinoxalines from *o*-nitrosoamines
3) Preparation of quinoxalines using α-amino acid intermediates.
4) By the dehydrogenation of 1,2,3,4-tetrahydro-quinoxaline
5) By the nucleophilic substitution of 2-amino-3-substituted quinoxalines

1) **Preparation of quinoxalines from o-diamines:**

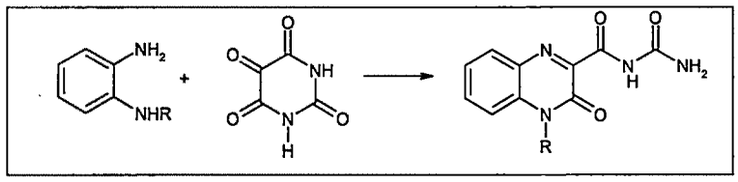
The classical synthesis of quinoxalines involves the condensation of an aromatic *o*-diamine and a α-dicarbonyl compounds. Also the condensation of α-ketoacids and o-phenylene diamines gives quinoxaline-2-one.[32]



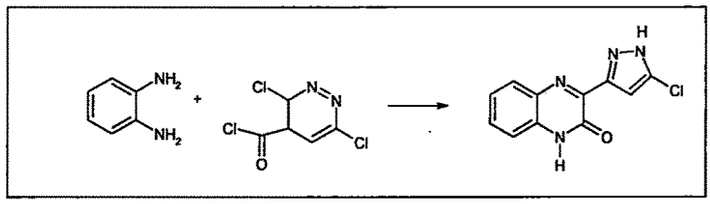
The condensation of diphenylpyruvic acid and *o*-phenylenediamine yields quinoxaline-2-one.[33]



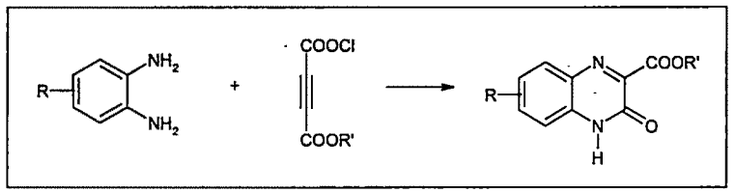
The condensation of *o*-phenylenediamine or N-methyl-*o*-phenylene diamine with alloxan and 1,3- dimethyl alloxan yields ureides and quinoxaline-3-one-2-carboxymethylamide respectively.[34-36]



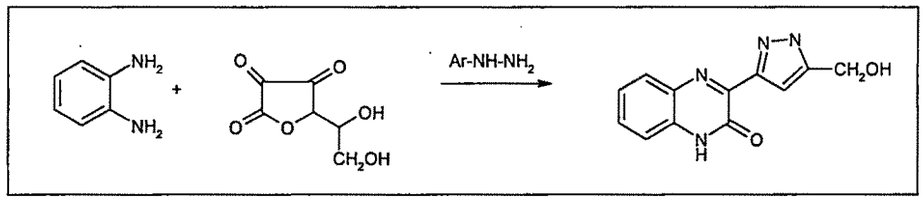
Quinoxaline derivatives have been prepared recently by reaction of o-diamines with osones, osonehydrazones and dehydro-L-ascorbic acid.[37]The synthesis of 3-(3-chloropyrazol-5-yl)-1,2-dihydro-quinoxaline-2-one reported by the Heinisch, Matuszczazov and Mereteira method.[38,39]



Synthesis of quinoxalines based on additive reactions was studied by Iwanami.[40,41]

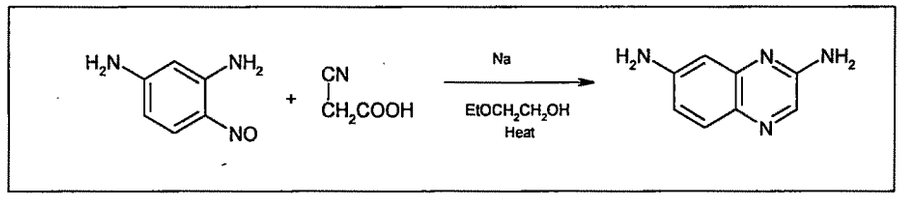


Lactones of α-ketocraboxylic acids are also suitable precursors for the preparation of 3-substitited quinoxaline-2-ones. The dehydroascorbic acid condenses with o-phenylene diamine and phenyl hydrazine to form pyrazolyl quinoxaline .[42,43]



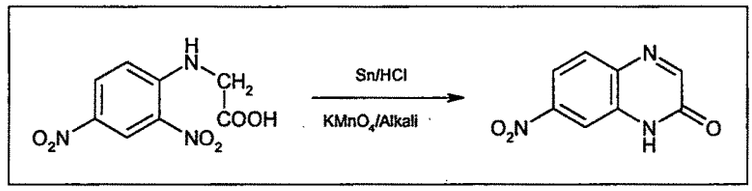
2) **Preparation of quinoxalines from o-nitrosoamines**:

The condensation of aromatic o-nitrosoamines with cyanoacetic acid or cyanoacetamide affords an unambiguous synthesis of unsymmetrically substituted quinoxalines.[44]



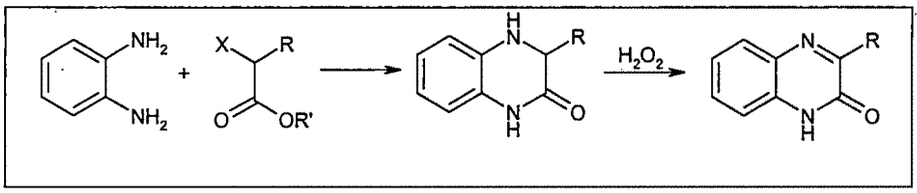
3) **Preparation of quinoxalines using α-amino acid intermediates:**

This method is widely applicable to the unambiguous synthesis of quinoxaline-2-ones, e.g. 7-nitroquinoxaline-2-one.[45]

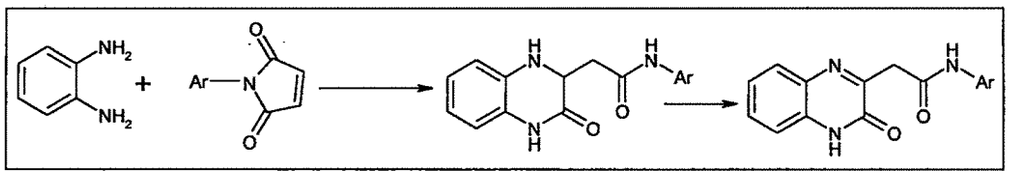


4) **By the dehydrogenation of 1,2,3,4-tetrahydroquinoxaline-2-one:**

The condensation of α-haloesters with o-phenylenediamine leads to the 1,2,3,4-tetrahydroderivative. The dehydrogenation of saturated ring proceeds smoothly under mild conditions by the action of hydrogen peroxide.[46]



Tetrahydroderivatives can be also prepared by the reaction of o-phenylene diamine with N-arylmaleinimides, followed by dehydrogenation with chloranil to give the corresponding substituted quinoxaline-2-one.[47]

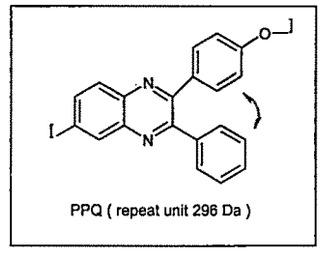


5) By the nucleophilic substitution of 2-amino3-substituted quinoxaline:

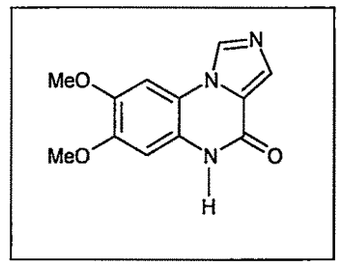
Nucleophilic substitution of 2-amino group is suitable if starting 2-aminoderivative is well available such as in the case of some aryliminonitriles. By the reaction of aryliminonitrile with o-phenylendiamine form amino derivative, which can be easily transformed to quinoxaline-2-one by the diazotisation and subsequent splitting of diazonium salt.[48]

1.2 Literature Survey:

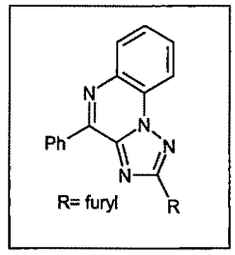
The scientist Michael J. Polce and etal studied the structural characterization of quinoxaline homopolymers and quinoxaline/ether sulfone copolymers by matrix-assisted laser desorption ionization mass spectrometry. Polyphenyl quinoxaline (PPQ) copolymers are synthesized by combining self-polymerizable quinoxaline monomers with a 1:1 molar mixture of 4,4'-dechlorodiphenyl sulfone and bisphenol.[49]



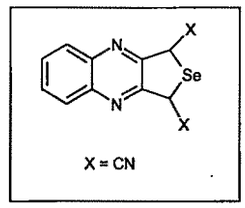
Bang-chi Chen and et al developed a new strategy for the construction of the imidazo [1,5-a] quinoxaline-4-one ring system. The new method involves condensation of o-nitroaniline with glyoxylate in methanol followed by the treatment of the resulting α-(o-nitroanilino)-α-methoxyacetate with tosylmethyl isocyanide reagent to give 1-(o-nitrophenyl)-imidazole-5-carboxylate. Reductive cyclization of the nitroimidazole carboxylate afforded imidazo [1,5-a] quinoxaline-4-one in three steps and 60% overall yield, like 7,8-dimethoxy imidazoquinoxalin-4-one.[50]



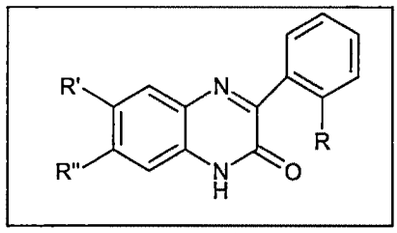
Alan R. Katritzky studied a novel rearrangement to 1,2,4-triazolo [1,5-a] quinoxalines. In that synthesis the reactions of benzyl bromide or benzyl cinnamate with N-(benzotriazol-1-yl methyl)arylimidoyl chlorides in the presence of t-BuOK occur with opening of the benzotriazole ring affording 1,2,4-triazolo[1,5-a]quinoxalines, like 2-furyl-4-phenyl-1,2,4-triazole [1,5-a] quinoxaline. [51]



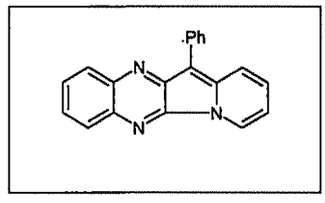
The scientist Emad Aqad, and et al synthesized stable seleno [3,4-b] quinoxaline derivatives like 1,3-dicyanoseleno [3,4-b] quinoxaline, which are useful in the polymers. The unstable seleno [2,3-b] quinoxaline was generated and functionalized in situ to give the stable dialdehyde and diester derivative. The dicyano compound was made in several steps from bis-cyanomethyl selenide and was found to be very stable.[52]



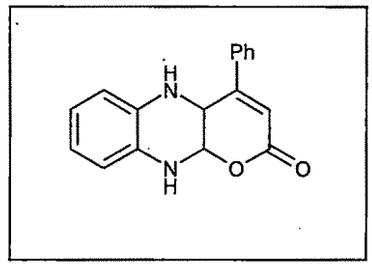
The synthesis of oxo-derivatives of quinoxaline and some arylhydrazones of 6,7-disubstituted 1,2-dihydroquinoxaline 3-carbaldehyde was studied by Lenka Zidkova and et al. The diatization of 3-(2-aminophenyl)-1,2-dihydro-quinoxaline-2-one afforded solution of the corresponding diazonium salt and by azo -coupling of these diazonium salts with 6,7-disubstituted-3-methyl-1,2-dihydroquinoxaline-2-ones, malonodinitrile and ethyl cyanoacetate to the corresponding hydrazones 3-{2-[(3-oxo-3,4-dihydro-quinoxaline-2-yl)methylenehydrazino]-phenyl}-1,2-dihydro-quinoxaline-2-one. Hydrazones were then cyclized with hydrazine to pyrazoles. [53]



The intermolecular nucleophilic substitution of 2-pyridinio-3-(α-pyridiniobenzyl)quinoxaline was studied by the scientist A.A. Kalinin and et al. The author found that dipyridinium salt formed from 2-chloro-3-(α-chlorobenzyl)quinoxaline at room temp. loses a mole of pyridinium hydrochloride and upon heating at reflux in pyridine and cyclizes to give 12-phenylindolizino [2,3-b] quinoxaline. The formation of this probably involves deprotonation of the benzyl carbon atom with three electron-withdrawing groups by pyridine and subsequent nucleophilic attack of the carbanion formed on the ortho carbon atom of the pyridinium substituents at C(2) of the quinoxaline system. This is followed by loss of pyridine from the benzyl position through a scheme of analogous to vicarious nucleophilic substitution, in which the 2-pyridinium group acts as the substrate, the pyridine lost acts as the vicarium and the substitution itself is an intramolecular.[54]

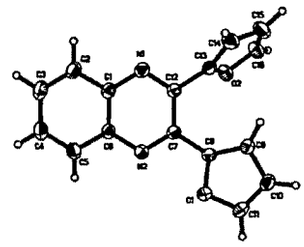


The scientist V. A. Mamedov and etal was studied the synthesis and XRD pattern of 3-benzoyl quinoxaline-2-(1H)-one and 2-oxo-4-phenylpyrano[2,3-b]quinoxaline.[55]

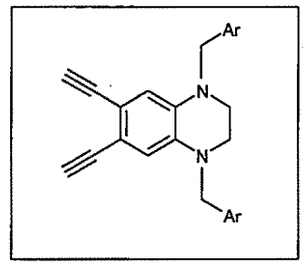


Jian-Zhong Wu and et al studied the structure and co-ordination behavior of 2,3-bis (2-furanyl) quinoxaline, which has some anti-pasmodic activity and crystallizes in the orthorhombic system. Organic compounds possessing bis-bidentate heteroatom sites are important building blocks in constructing bimetallic or oligonuclear coordination compounds. [56]

2,3-bis(2-furanyl)quinoxaline



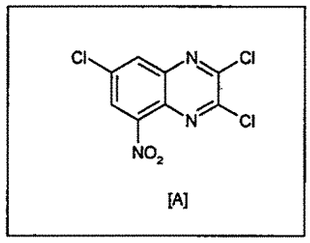
The scientist I. G. Abramov studied the synthesis of N, N'-alkylated tetrahydroquinoxalines by the reaction of 4-bromo-5- nitrophthalonitrile with secondary diamines. For example 1,4-dibenzyl-1, 2,3,4-tetrahydro-6, 7-quinoxaline dicarbonitrile.[57]



Thus, 4-(p-substituted-phenyl)-3-mercapto-5-(2'morpholino)- quinoxaline-1,2,4-triazoles was synthesized from ethyl-2-hydroxy quinoxaline-3-

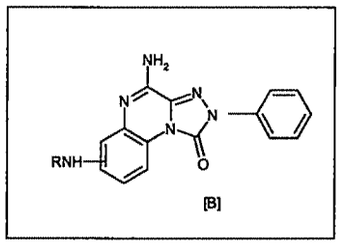
carboxylate.[58] The reaction of 6,7-dichloro-5,8-quinoxalinedione with aromatic and aliphatic dinucleophiles and molecular modeling study of their intercalation complexes was studied by the scientist Hee-Won-Yoo.[59]

The scientist Jun Hyun Kim and etal studied that 2,3,7-trichloro-5-nitroquinoxaline (TNQX) as a gughky potent and selective anti-telomerase agent and as a promising anti-cancer agent.[60]



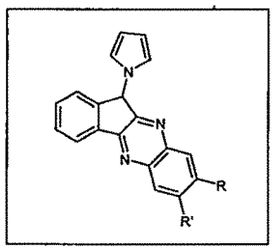
[A]

The 4-amino-6-bynzylamino-1,2-dihydro-2-phenyl-1,2,4-triazolo [4,2-a] quinoxaline-1-one was found to be potent and selective adenosine receptor antagonist.[61]



[B]

The 11H-Indeno[1,2-b] quinoxaline-11-ones generated in situ from ninhydrin and various 1,2-phenylenediamines, catalyzed by montmorillonite K10 under microwave irradiation, and condensed with 4-hydroxyproline to produce 11-(1H-pyrrol-1-yl)-11H-indeno[1,2-b] quinoxaline derivatives in good yields.[62]

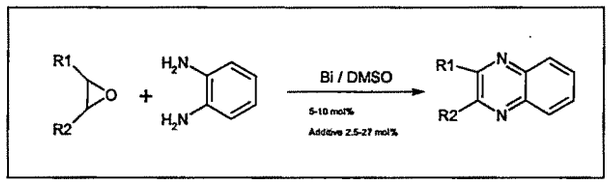


The synthesis and halochromism of new quinoxaline fluorescent dyes e.g. 6,7-bis-(3-methylbutoxyl)quinoxaline was studied by Jae-Yun Jaung.[63]

Pratt and Keresztesy have reported the synthesis of indolizino and dihydroindolizino quinoxalines from either the reaction of 2,3-dichloroquinoxaline with ethyl cyanoacetate and isoquinoline in a one step process.[64]

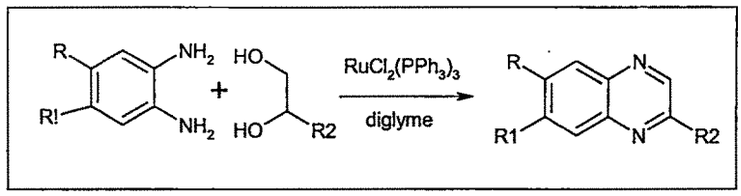
Similarly 2,3-dichloroquinoxaline and some of its derivatives have been reacted with malononitrile and ethyl cyanoacetate to yield a variety of 3-chloro-2-(cyanomethylene)-1,2-dihydroquinoxaline derivatives.[65]

Sylvain Antoniotti and Elisabet Dunach reported new strategy to prepare differently substituted quinoxalines directly from simple epoxides and ene-1,2-diamine compounds, in a oxidative coupling catalyzed by bismuth powder.[66]



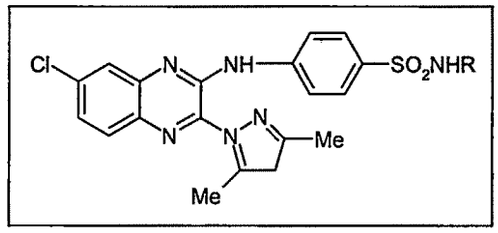
Zemin Wu and et al reported the first solid-phase synthesis of quinoxalines, recently developed on SynPhase™ Lanterns.[67]One of the most reported multi-component reactions is the Ugi-reaction. The scientist Cedric Kalinski and co-workers reported a new and versatile Ugi/S_NAr synthesis of fused 4,5-dihydrotetrazolo [1,5-a]quinoxalines.[68]

A new ruthenium-catalyzed approach for quinoxalines from 0-phenylenediamines and vicinal-diols was studied by Chan Sik Cho and et al.[69]

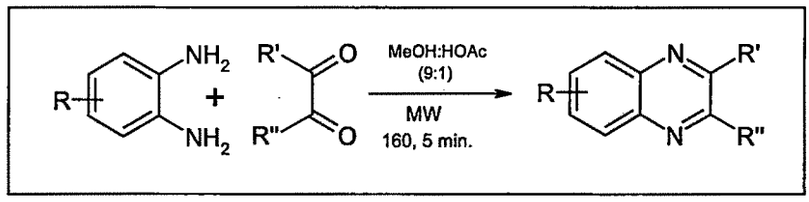


Emma Ford and co-workers described the novel regioselective substitution of 2,3-dichloro-6-amino-quinoxaline.[70]Sessler and co-workers demonstrated that dipyrrolylquinoxalines (DPQ) present the topological features.[71]The scientist Florence Szydlo and etal described synthesis of functionalized dipyrrolyldiketones, precursors of quinoxaline containing macrocycles.[72]

The synthesis of 2-(pyrazol-1-yl) quinoxalines and 2,3-di (pyrazol-1-yl)quinoxalines described by Ho Sik kim and et al, like 6-chloro-2-(3,5-dimethylpyrazol-1-yl)-3-(4-sulfamoylanilino)quinoxaline.[73]



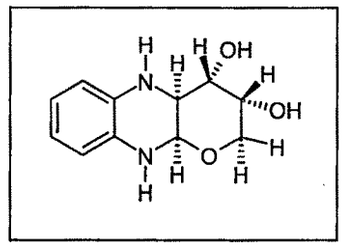
The microwave assisted protocols for the expedient synthesis of quinoxaline described by Zhijian Zhao and co-workers.[74]



Antonio Arcadi and co-workers synthesized 2,3-disubstituted pyrrolo [2,3-b] quinoxalines via aminopalladation reductive elimination.[75]

Joule and co-workers have described a linear synthesis of pyranoquinoxalines and the cobalt complex as a model complex related to molybdopterin (MPT).[76,77]

Shyamaprosad Goswami and Avijit Adak studied a novel on-pot two-component synthesis of tricyclic pyrano [2,3-b]quinoxalines.[78]

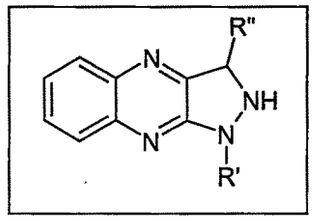


Ismail Yilmaz and co-workers studied the synthesis and characterization for the 2,2'-azoquinoxalines substituted with long alkoxy chains and halogen groups and a binuclear cyclopalladated symmetrical azo-quinoxaline complex.[79]

The scientist Frieder Mitzel and et al described that octa-alkynyltetra [6,7] quinoxalinoporphyrazines used as photosensitizers for photodynamic therapy.[80]A novel 1,3-dipolar cycloaddition of quinoxalinium N-Ylide to alkene promoted by MnO_2 a new approach to synthesis of pyrrolo [1,2-a] quinoxalines was studied by Jian Zhou and et al.[81]

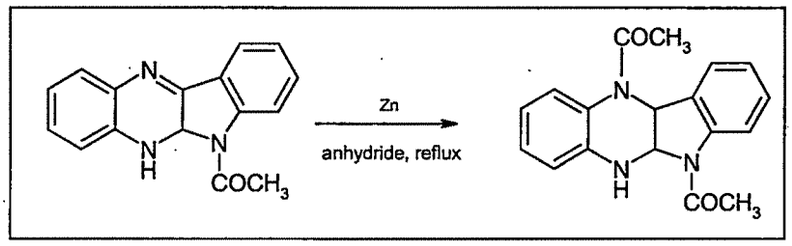
The synthesis, crystal structure, molecular orbital calculations and electronic properties of 2,3-di (2-pyridyl)naphtha[2,3-f]quinoxaline-7,12-quinone (Aqdpp) was described by Rosa Lopez and co-workers.[82]The scientist Eva Csikos and etal described the regioselectivity in preparation of unsymmetrically substituted 3-aminoquinoxaline-2(1H)-ones.[83]

The synthesis ^{1}H, ^{13}C, ^{15}N NMR spectroscopic and quantum chemical study of 1H-pyrazolo[3,4-b] quinoxalines (flavazoles) was studied by Matthias Heydenreich and et al [84]



The scientist Michail G.Ponizovsky and co-workers described the synthesis of fused quinoxalines.[85]The cascade cyclization of quinoxaline with nitriles of α,β-acetylenic γ-hydroxy acids done by Ludmila V.Andriyankova and et al.[86] The solid phase synthesis of quinoxaline analogues through a benzyne intermediate studied by the Seth Dixon and co-workers.[87]

A new approach to synthesize pyrrolo [1,2-a] quinoxaline derivatives studied by Xue-chun Zhang and et al.[88]The reduction of indolo [2,3-b] quinoxalines with zinc in the presence of an anhydride was studied by Robert Engqvist and co-workers.[89]



The cyclo-dimerization of acyl-(3-oxo-2-quinoxalinyl)ketenes was reported by the A.N.Maslivets and et al.[90]

1.3 Scope of present work:

Among a wide variety of nitrogen heterocycles that have been explored for developing pharmaceutically important molecules, quinoxalines have played an important role in medicinal chemistry in cancer treatment, as the herbicides, as well as the analytical reagents for the detection and estimation of metals, and as a thermo stable oil additives.[91]

Quinoxaline constitute useful intermediates in organic synthesis. They have been reported for their applications in dyes, also been used as building blocks for the synthesis of organic semiconductors.[92,93]

Certain cyanine derivatives of quinoxaline have been reported as dyes.[94]Also quinoxaline derivatives have shown a broad spectrum of biological activities such an antibacterial and anti-inflammatory. The quinoxaline derivatives have been evaluated as anthelmintic agents.[95] Pyrano [2,3-b] quinoxaline have been proven to be the most promising model substrates related to the molybdopterin (MPT) of molybdenum co-factor (Moco). [96] Quinoxaline plays an important role as a basic skeleton for the design of many pharmacologically and biologically active compounds such as insecticides, fungicides, and herbicides.[97] The quinoxaline nucleus is present in many pharmaceutical agents exhibiting a broad spectrum of biological activities such as antiviral, antiglucom agent. Recently, novel pyrrolo [1,2-a] quinoxalines have been proved to be potent and selective 5-HT_3 receptor ligands. 1H-pyrazolo[3,4-b] quinoxalines were found to be highly tuberculostatic.1-(4-Nitrophenyl)-1H-pyrazolo[3,4-b]quinoxaline-3-carbohydrazide proved to be of highly anti-bacteriological activity Vs both gram positive and gram negative bacteria. When pyrazolo [3,4-b] quinoxaline substituted in position 3 by another heteroaromatic moieties showed fungicidal activity.

Quinoxaline chemistry is again in the center of interest because of these compounds possess CNS activity. Quinoxalines being important in natural products and chemotherapeutic agents.[98] Quinoxaline antibiotics enhance peptide nucleic acid binding to double stranded DNA.[99] The drug reported thus far in the quinoxaline series is sulfaquinoxaline and its derivatives which are effective against bacterial infections. Sulfaquinoxaline is used in the treatment of coccidiosis in chickens.[100, 101]

The simple quinoxaline have not been found in nature. Riboflavin or vitamin B_2 (I) is a member of a more complex series of quinoxaline derivatives.

Also quinoxaline based materials were used as ETLs or (Electron transporting layer) or hole blocking layers in OLEDs (organic light emitting diodes). [102,103]Such wide spectrums of biological activities are associated with molecules containing quinoxalines motivated us to undertake the synthesis and testing of the biological activities of some new derivatives of quinoxaline.

1.4 Objectives of the present work:

1) Synthesize various tetrazolo quinoxalines for pharmaceutical activities.
2) Synthesis of the quinoxaline compounds by microwave irradiation technique, which reduces the reaction time from hours to few, seconds and increases the yield of the products.
3) The XRD crystal structure analysis of some quinoxalines.

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