

**Nitrogen based Heterocycles as an Anti-cancer agent**

**(Project Code: BSCH358)**

**A**

**Report submitted to partially fulfilment of the  
Requirement for the degree of  
Bachelor of Science in Chemistry**



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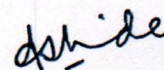


## DECLARATION

I, **Aarti Gangadhar Shinde**, a bona-fide student of B.Sc. Chemistry of K. R. Mangalam University, Sohna, Gurugram would like to declare that the dissertation entitled "**Nitrogen based Heterocyclic Compound as an Anti-cancer agent**" submitted by me in partial fulfilment of the requirement for the award of the degree of Bachelor of Science in Chemistry is our original work.

Place: Sohna

Date: July 11<sup>th</sup>, 2022



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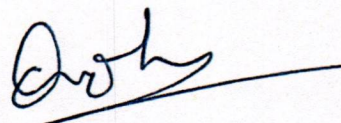
## CERTIFICATE

This is to certify that the dissertation entitled "**Nitrogen based Heterocyclic Compound as an Anti-cancer agent**" is a bonafide record of the work done by **Ms. Aarti Gangadhar Shinde** (Roll no. **1903100008**) under my supervision and submitted to K. R. Mangalam University is partial fulfilment for the award of the degree of Bachelor of Science in Chemistry.

Date: July 11<sup>th</sup> 2022

  
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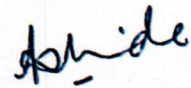
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## ACKNOWLEDGEMENT

A work is never successful completed without the assistance and guidance from appropriate person. So, it is time to express our sincere gratitude toward all persons who have helped us to complete our work.

First and foremost, we would like to express our deep sense of gratitude and sincere thanks to our supervisor **Dr. Chandra Mohan** for his guidance, endeavour throughout the course which helped us in timely completion of this work.



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## ABSTRACT

Cancer is a leading cause for death worldwide. There is no such medicine which can destroy cancer cells. But the advancement in heterocyclic compounds especially the nitrogen based has gained much attention in the recent years. More than 50% of drugs bear heterocyclic compounds and among them nitrogen containing heterocycle compound shows superior pharmaceutical effect than non-nitrogen compounds. Indole based heterocyclic compounds play an important role in cancer treatment especially breast cancer. Surgical radiotherapy and chemotherapy methods are the alternatives to treat cancer. Chemotherapy plays major role in the medical attention of cancer but have some side-effects. This review paper comprises further classification of anti-cancer drugs and nitrogen based heterocyclic compound, indole and its derivatives as anti-tumor agents.

**KEYWORDS:** Heterocyclic compounds, Indole and its derivatives, Cancer cells, Nitrogen Based.



# NITROGEN BASED HETEROCYCLES AS AN ANTI-CANCER AGENTS

## 1. Introduction

Heterocyclic compounds, cyclic compounds forming a ring containing two different elements one is the C-atom and other elements known as the hetero-atoms being nitrogen, oxygen, sulphur are members of its ring. The prefix 'hetero' came from the Greek word, hetero which means different or the other (of two) and cycle as a suffix in the term refers to the cyclic compounds building up a ring. The representative case of heterocyclic compounds contains, Majority of drugs are nitrogen-based and heterocyclic, all necessary micronutrients vitamins and minerals, Nucleic Acids that are accountable for the storage and expression of genomic information. Pesticides, pure and man-made drugs and plastics are examples of heterocyclic compounds. There is a huge list of heterocyclic compounds. To avoid any kind of confusion the heterocycles are classified based on their **Electronic Arrangement**.

S.no.	Aliphatic Heterocyclic Compound	Aromatic Heterocyclic Compound
1.	The Cyclic heterocycles which do not contain double bond	The cyclic heterocycles compounds containing double bond are called aromatic heterocyclic compounds.
2.	The characteristics of these compounds are mainly affected due to ring strain.	These compounds obey Huckel's Rule i.e., it must have $(4n+2)$ $\pi$ electrons, planar structure, $sp^3$ hybridisation,
3.	Tetrahydrofuran (THF), Ethylene Oxide, Piperidine, Pyrrolidine, Dioxane etc are some common examples of Aliphatic Heterocyclic compounds.	Aromatic heterocyclic compounds are the analogues series of benzene for example Pyrimidine, Pyridine, Purine, Pyrazole, Indole, Benzofuran, Furan, Pyrrole etc



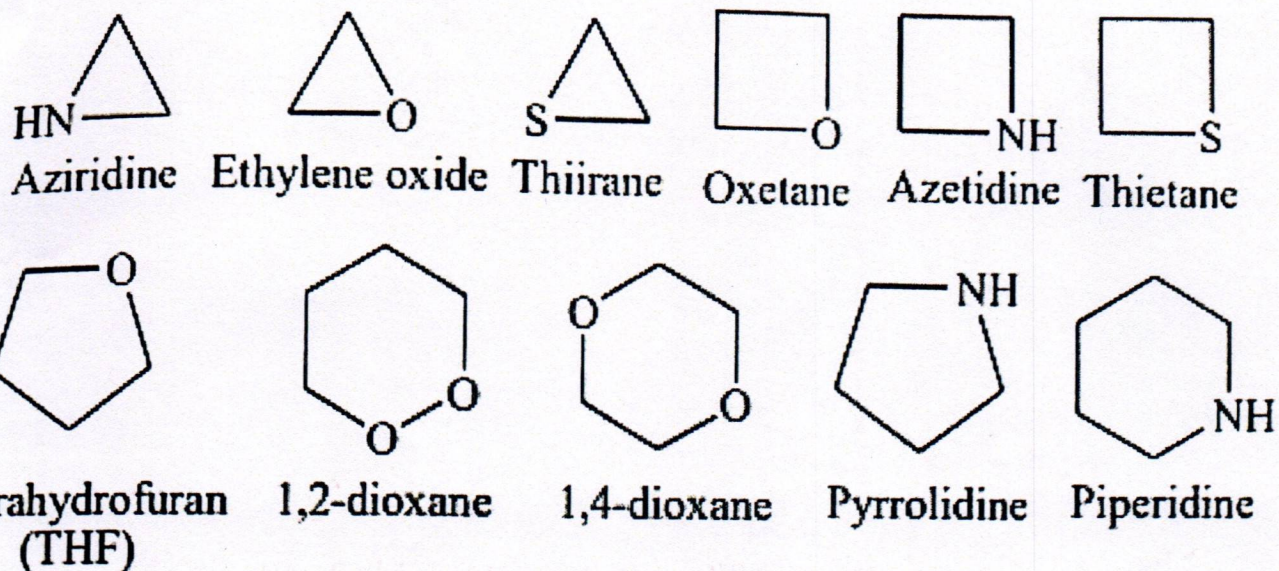


Fig.1.1 Aliphatic Heterocyclic Compounds

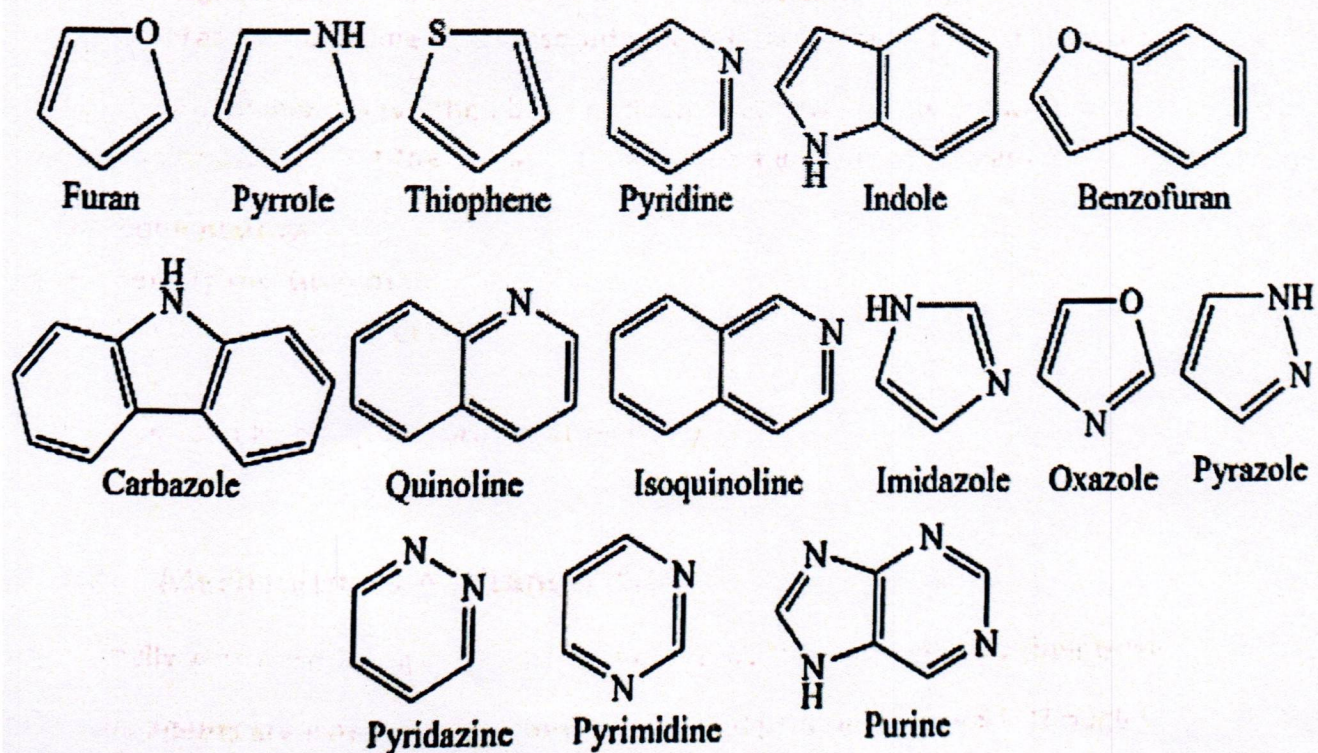


Fig.1.2 Aromatic Heterocyclic Compounds



Depending up on **Structure**, The Heterocycles are classfled into three, four, five, & six-member heterocyclic rings. The heterocyclic ring contains the number of heteroatom respective to their names. Also, these are further classified into the heterocyclic rings containing one or more than one hetero-atom. Aziridine, Azirine, Diaziridine, Azetidine, Azete, and Diazetidlene are three and four membered heterocyclic rings. The commonly used heterocyclic compounds are Indole, Pyrrole, Pyrazole, Pyridine, Pyradizine, Pyrimidine, and Pyrazine which is categorised among four, five, and six membered heterocyclic rings. [1]

These compounds are also categorised as **Condensed or Fused Heterocyclic Compounds**. In this category the compound consists of more than two fused rings. Purine, Quinoline, Isoquinoline, Pteridine, etc

### 1.1. Anti-cancer Drugs

The third most fatal disease after cardiovascular, parasitic and infectious disease in the world is **Cancer** says the statement from American Cancer Society. [2,3]. Medical need for cancer is one of the most demanding areas in scientific research. Treatment of tumor is carried by using various techniques like chemotherapy, radiotherapy, surgery and immunotherapy in combination or singly along with kinase inhibitor. The kinase inhibition concept is mostly used.

Radiation therapy is oftentimes enforced in a limited setting and assemble with surgical steps. And the last one, drugs, these are implemented with chemotherapy (CTX), which employs a wide group of drugs that have cytotoxic effects. [4] The anti-cancer drug hinders cell growth along with proliferation. These medication eradicate the cancer cells and ordinary cells also.

Anticancer medications have the ability to destroy cytotoxic cells by blocking their growth.

[4] Anticancer drugs affect the division of multiple cancerous as well as ordinary like:

- Bone marrow
- Sex organs (Gonads)
- Gastrointestinal tract
- Skin
- Liver and kidney (slow proliferating cells)

### 1.2. Mechanism of Anticancer drugs

Traditionally anticancer drugs are classified either by their action or by their origins.

Alkylating agents are extremely reactive to DNA and proteins (cellular). Though the primary mode of action is mostly through:

- 1) Cross-linking of DNA strands
- 2) Inhibiting replication of DNA
- 3) Transcription of RNA



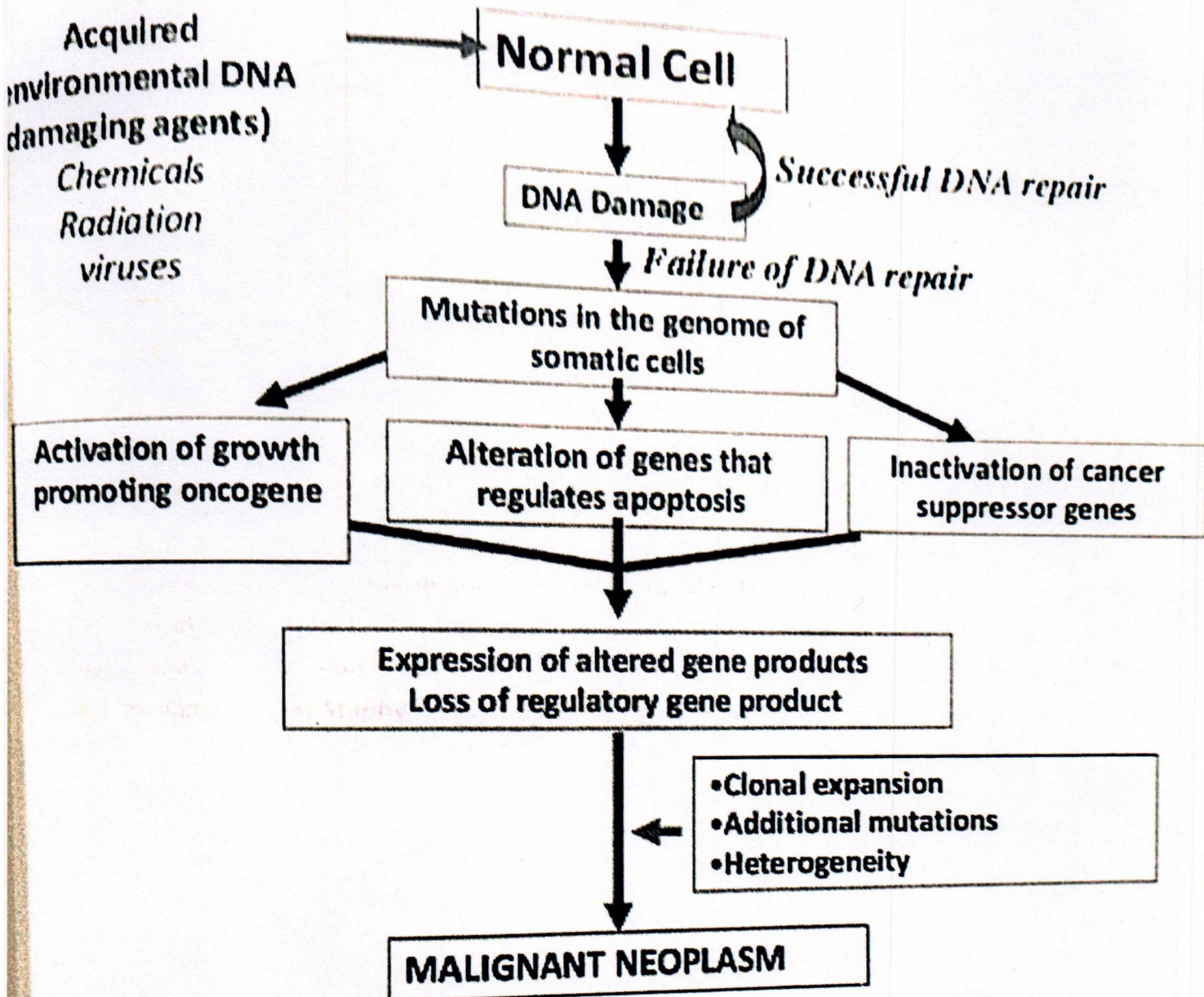


Fig.1.1 Mechanism of various anticancer drugs [5]

Chemotherapy is a different approach to treat cancer other than surgery and radiation therapy. Rather than physically removing a tumor or a part of it, chemotherapy uses anti-cancer or cytotoxic drugs to treat cancer cells to control its growth.[6]. For example, a breast cancer patient who had a primary tumor and his positive axillary nodes were removed surgically and received chemotherapy and regional radiation.[7]