INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN(O): 2455-0620 [Impact Factor: 7.581]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 9, Issue - 2, February - 2023 Publication Date: 28/02/2023

DOIs:10.2015/IJIRMF/202302022 --:-- Research Paper / Article / Review

A Review on Recent Developments in N-Heterocyclic Molecules and Their Biological Applications

Bhoomika Gajjar[1], Hiral Shah[2], Panchal Dhruv[3] and Seema Kher[4]
[1 & 2]Department of Chemistry, Ananya Institute of Science, Kalol-382721
[3 & 4]Department of Chemistry, Monark University, Ahmedabad-382330
Email - ananya.kirc2014@gmail.com

Abstract: *In medicinal chemistry, the modulators of nitrogen-based heterocycles have a unique place as a valuable source of therapeutic medicines. Drugs that have been FDA-approved and are currently on the market more than 75% of the cases contain heterocyclic nitrogen molecules. New heterocyclic compounds based on nitrogen are now being developed with significant applications in the medical area and new noteworthy features. Heterocyclic compounds based on nitrogen will be essential for the creation of novel pharmaceutical medicines. Numerous brand-new nitrogen-based heterocycles have been created and their important physiological features thoroughly researched. This review article compiles such innovative nitrogen-based heterocycles, their biological functions, and their potential medicinal applications to further therapy.*

Key Words: *Nitrogen-based heterocycles, Physiological features, Medical area, Biological functions and applications.*

1. INTRODUCTION :

In organic chemistry, heterocycles are a wide and diverse family of substances. They are aromatic or non-aromatic scaffolds that include one or more atoms (most common, oxygen, nitrogen, and sulfur). There are several compounds that also contain silicon and phosphorus. These atoms, which make up a small part of the ring, are referred to as heteroatoms. Due to their potential biological activities and significance in the fields of pharmaceuticals, agrochemicals, and industrial materials, heterocyclic synthesis is a pivotal step in medicinal chemistry. The formation of novel compounds and composites is a key area of study in nitrogen-based heterocyclic chemistry, which constitutes a significant and distinctive class among the applied areas of organic chemistry. Over the past two decades, these compounds have generated more and more interest. Our purpose is to research and create newer heterocyclic compounds that may be useful in various fields. Utilizing spectroscopy and elemental analysis, the reaction process would be investigated, and the structures of all novel compounds will be confirmed.

This field is deals with applied areas of Industries such as novel compounds synthesis with advance properties. Branch has developed significantly for inventing novel molecules as well as modification of molecule composition. These molecules have received increasing attention over the past two decades. . Heterocyclic compounds, as the most important organic compounds, are frequently present in molecules of interest in medicinal chemistry. Among all of them, nitrogen containing heterocycles are of great importance to life science, since they are abundant in nature, existing as subunits in several natural products, for example vitamins, hormones and antibiotics.

2. The Relevance of Heterocyclic Compounds in Biological Study

The chemistry and medical life concerns are connected by medicinal chemistry, which is important. With their inherent adaptability and distinctive physicochemical features, heterocycles in medicine have a crucial role to play in the fight against many severe illnesses. Numerous pharmacologically active heterocyclic compounds are used as anti-cancer, anti-inflammatory, antibacterial, herbicides, urinary antiseptics, and anti-inflammatory medicines in the treatment of many common ailments. Here, we discussed a few compounds with potential as medicines.

3. Anticancer activity

A series of disorders known as cancer include abnormal cell proliferation and have the potential to infiltrate or spread to other bodily areas. Numerous factors, including chemical compounds and radiation light, might cause this illness. Many different medications are used to treat this illness, either by destroying cancer cells or by altering their

development. We'll go through the most recent synthetic substances utilized for this.
The 6-OH-Phenanthroquinolizidine alkaloid and its derivatives were created and have a strong anticancer effect by slowing the cell's development through the S phase by Liu et al. [1]

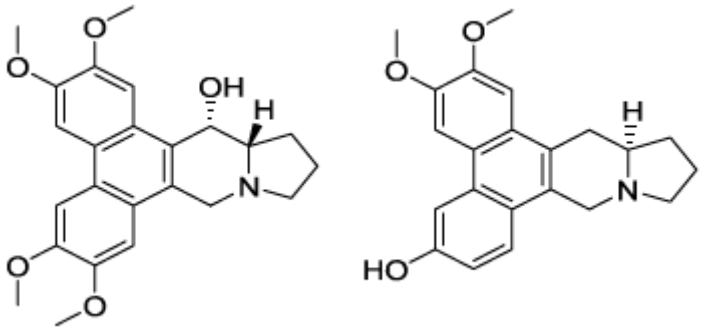


Figure: 1

At the National Cancer Institute, Cairo, Egypt, Morsy et al. [2] synthesised new derivatives of coumarin-containing compounds that demonstrated anticancer activity when biologically screened against two human tumour cell lines, breast carcinoma Michigan Cancer Foundation-7 (MCF-7) and hepatocellular carcinoma (HepG-2), using 5-fluorouracil as the standard drug. Several of the synthetic compounds' structures are shown in below figure.

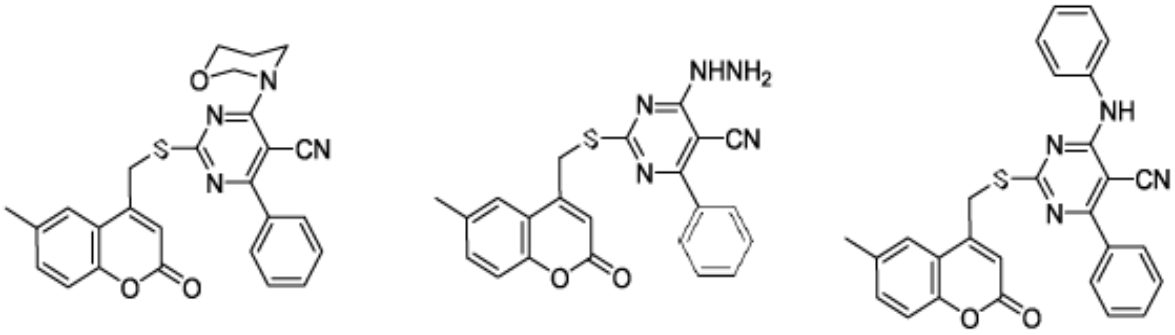


Figure: 2

Fused chromeno[4,3-b] pyrrolo [3,2-h] quinolin-7(1H)-one was synthesised by Thigulla et al. [3], and they also tested the anticancer activity of the resulting compounds. We display a few of these compounds here.

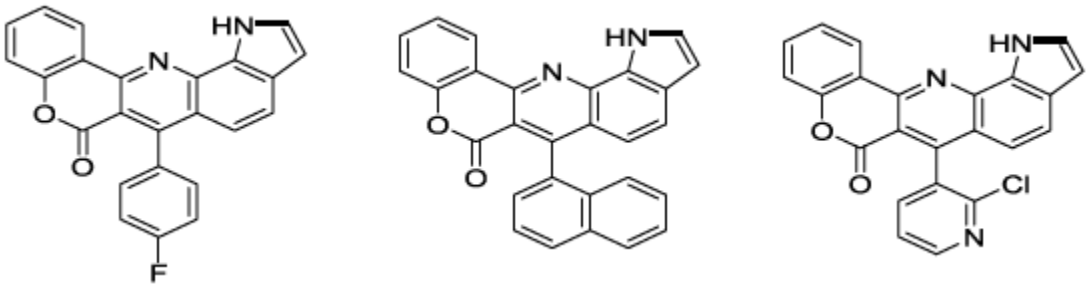


Figure: 3

4. Anti-inflammatory activity

Anti-inflammatory term is referring to the substances that used to treatment or reduces inflammation or swelling. Approximately 50% of anti-inflammatory medications are analgesics. Aspirin, ibuprofen, and naproxen are the most prevalent anti-inflammatory medications; this class of medication is known as a non-steroidal anti-inflammatory medicine (NSAID), which distinguishes it from steroids. These medications work by preventing the cyclooxygenase

(COX) enzymes from becoming active. These enzymes function in the arachidonic acid metabolism. Some NSAIDs may target the isoenzymes of cyclooxygenase.

Newer 2-(2-benzothiazolyl)-6-aryl-4, 5-dihydro-3(2 H)-pyridazinones were discovered by Sawhney and Bhutani [4], who reported that they have low to moderate anti-inflammatory action.

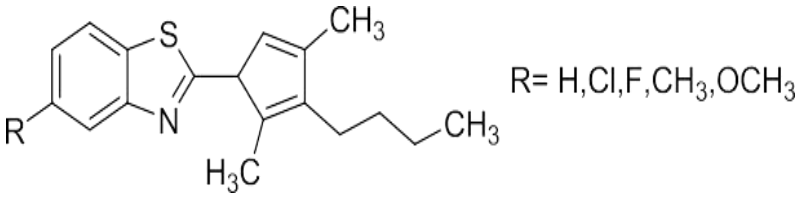


Figure: 4

Six compounds from Nauclea officinalis (Pierre ex Pit.) were extracted by Li et al. [5] and their activities were compared.

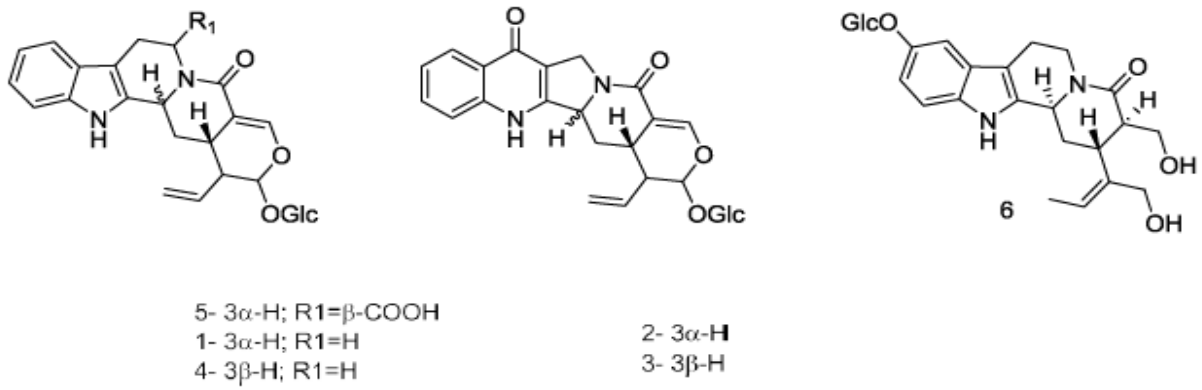


Figure: 5

Ghattas et al. [6] created various derivatives of 4,6-diamino-3-cyano-2-methylthiopyridine and demonstrated the anti-inflammatory properties of these compounds using a conventional method of carrageenan-induced paw oedema.

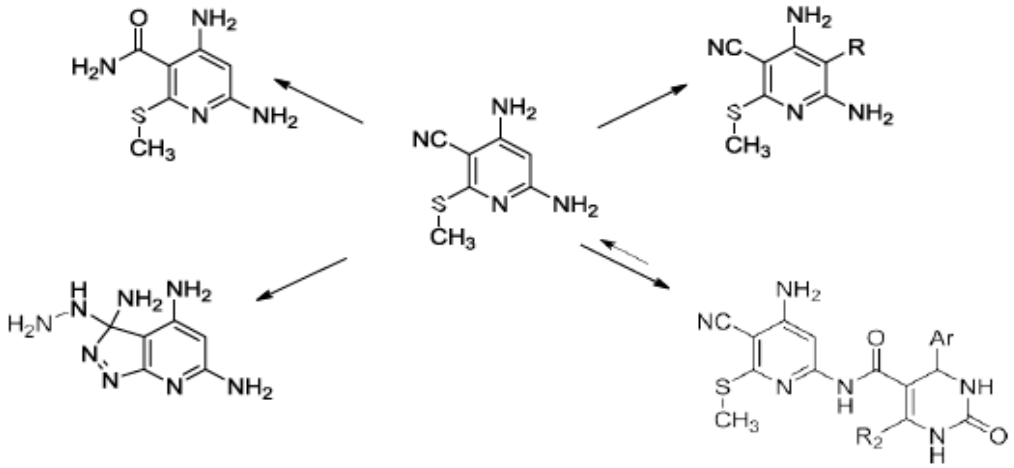


Figure: 6

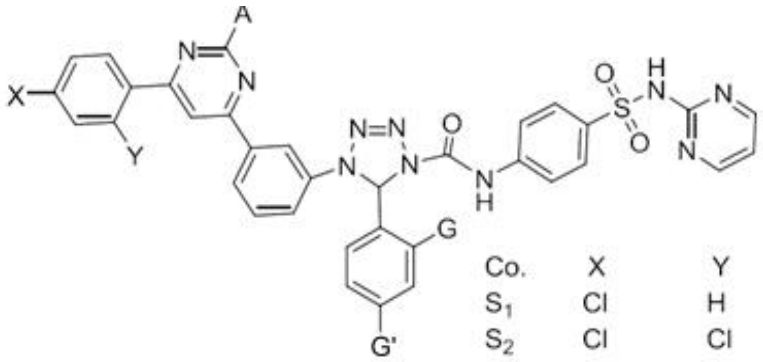
5. Antibacterial activity:

The phrase "antibacterial" or "antibiotics" is used to refer to medications that either kill or hinder the development of bacteria and are used to treat or prevent bacterial illnesses. Some of the antibiotics also have antiprotozoal action. Antibiotics are ineffective against viral diseases like the flu and the common cold. If antibiotics

INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN(O): 2455-0620 [Impact Factor: 7.581]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 9, Issue - 2, February - 2023 Publication Date: 28/02/2023

were used in an improper manner, resistant bacteria can evolve. Antibiotics are categorised based on their chemical structures or modes of action. Several scientists have created numerous compounds with this sort of action and tested them on various bacteria species. Aromatic heterocyclic derivatives, such as -lactam derivatives, comprise a major component of antibiotics' chemical structures. Some of the works over the last two years will be reviewed.

Based on sulfadiazine, Abbass and Zimam [7] developed novel pyrimidine and 1,2,3,4-tetrazole derivatives and evaluated these substances on two different bacterial species: Streptococcus spp. (Gram-positive bacteria) and Porphyromonas gingivalis (Gram-negative bacteria).



Co.	X	Y	A	G	G'
S_1	Cl	H	OH	$N(CH_3)_2$	H
S_2	Cl	Cl	SH	Br	H
S_3	$N(CH_3)_2$	H	SH	Cl	Cl
S_4	OCH_3	OH	OH	Cl	H
S_5	Br	H	NH_2	OH	H

Iqbal et al. [8] have synthesised some N-substituted acetamide derivatives of 1,3,4-oxadiazole nucleus derivatives bearing azinane and have tested their antibacterial activity against five different bacterial strains, including Salmonella typhi, Escherichia coli, P. aeruginosa, S. aureus, and Bacillus subtilis. Although all of the produced compounds are just mild inhibitors, Gram-negative bacterial strains are more susceptible to their effects. 5-[(4-Chlorophenyl)sulfonyl)] piperidin-4-yl [N-(2-methylphenyl)-2- acetamoyl]-2-thio] With exception of S. aureus, 1,3,4-oxadiazole is the strain with the highest level of activity as a growth inhibitor.

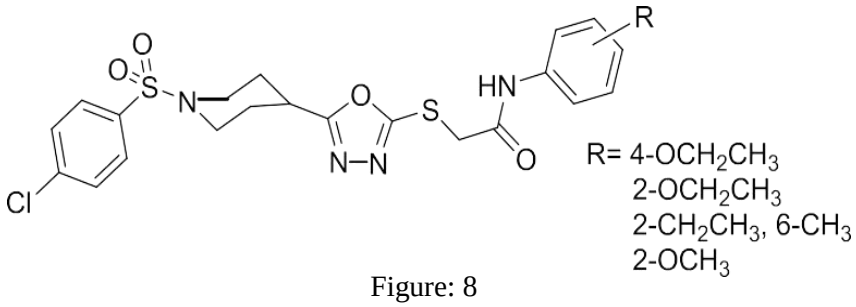


Figure: 8

New tetracycline derivatives have been generated by Deng et al. [9]. The broad range antibacterial drug 1,7-trifluoromethyl-8-pyrrolidinyltetracyclines had improved potency against P. aeruginosa.

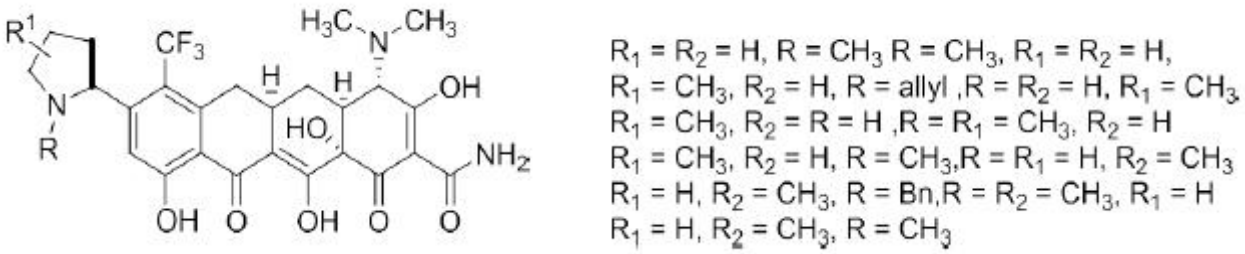
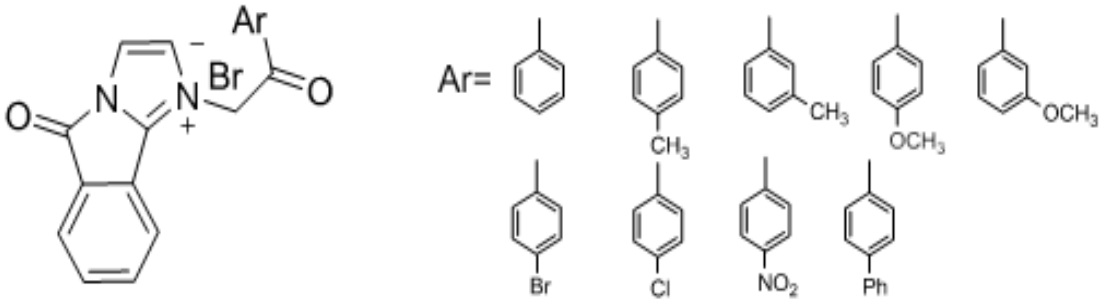


Figure: 9

An excellent new broad spectrum antibacterial agents which is a novel substituted imidazo[2,1-a]isoindole derivatives and tested it *in vitro* against two Gram-positive bacteria [*S. aureus* and *B. subtilis*] and two Gram-negative bacteria [*E. coli and Proteus vulgaris*] with streptomycin as standard drug (positive control) described by Narsimha et al. [10].



6. Herbicidal activity :

Many medications may kill undesirable plants and certain grasses without harming food crops; some heterocyclic derivatives have this property, and we'll go through some newer synthetic versions of this kind of medicament.

Molecular docking and Quantitative Structure-Activity Relationship (QSAR) analysis of fused heterocyclics as herbicide inhibitors of D1 protein in plant photosystem II have been performed by Ana and Luminita [11]. One on the substances covered by this investigation is provided here.

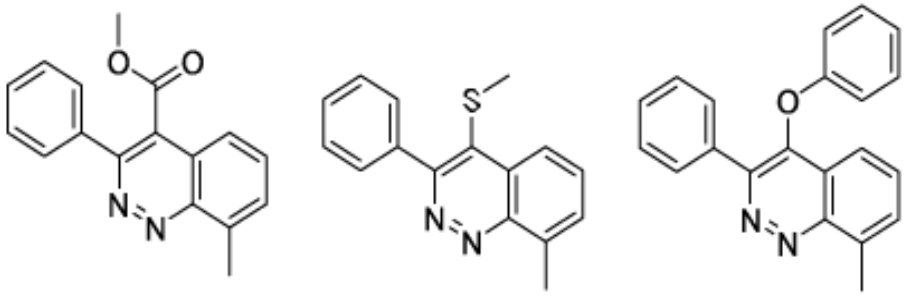


Figure: 11

a- [(substituted phenoxybutyryloxy or valeryoxy)] alkylphosphonates and 2-(substituted phenoxybutyryloxy)alkyl-5,5-dimethyl-1,3,2-dioxaphosphinan-2-one containing fluorin have been prepared by Wang et al. [12]. These substances were tested in a greenhouse and demonstrated herbicidal effects against various weed species.

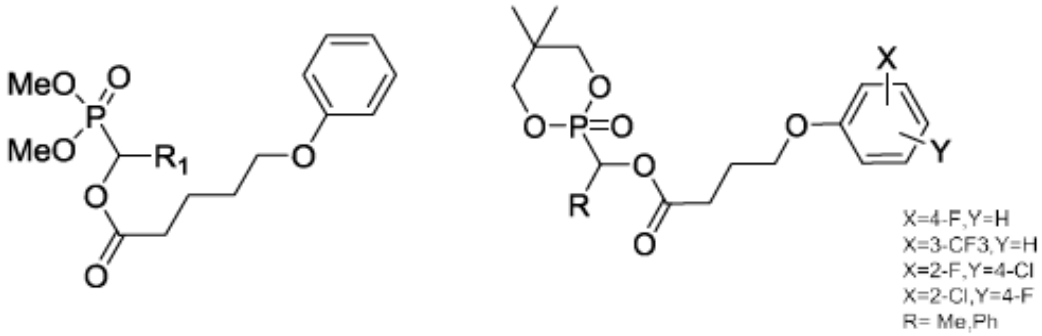


Figure: 12

7. CONCLUSION :

Heterocycles represent the majority of the substances we recognize as medications, vitamins, and several other natural items. As a result, heterocyclic chemistry is the subject of a great majority of chemical study. Due to the evident usage of chemicals formed from heterocyclic rings in pharmacy, medical, agricultural, plastic, polymer, and other industries, it is a significant and growing area of chemistry. There are many heterocyclic compounds in nature.

They might be used to treat infectious disorders because of their therapeutic qualities. Numerous in-lab produced heterocyclic compounds have been effectively employed as therapeutics.

REFERENCES :

1. Y. Liu, L. Qing, C. Meng, J. Shi, Y. Yang, Z. Wang, G. Han, Y. Wang, J. Ding, L.H. Meng, Q. Wang, *J. Med. Chem*., **2017**, 60(7), 2764- 2779.
2. S.A. Morsy, A.A. Farahat, M.N.A. Nasr, A.S. Tantawy, *Saud. Pharm. J*., **2016**, 1-10.
3. Y. Thigulla, T.U. Kumar, P. Trivedi, B. Ghosh, *Chem. Sel*., **2017**, 7, 2721-2724.
4. D.V. Sa whney, S.N.S. Bhutani, *Chem. Inform.*, **1987**, 18(43), 55-62.
5. D. Li, J. Chen, J. Ye, X. Zhai, J. Song, C. Jiang, J. Wang, H. Zhang, X. Jia, F. Zhu, *J. Ethnopharmacol*., **2017**, 196(100), 66-74.
6. A.E.A.G. Ghattas, A. Khodairy, H.M. Moustafa, B.R.M. Hussein, *J. Heterocycl. Chem*., **2016**.
7. A.F. Abbass, E.H. Zimam, *Int. J. ChemTech Res*., **2016**, 9(11), 206-217.
8. K. Iqbal, Q. Jamal, J. Iqbal, M. Sadaf Afreen, M.Z. Ahmed Sandhu, E. Dar, U. Farooq, M.F. Mushtaq, N. Arshad, M.M. Iqba, *Trop. J.Pharm. Res*., **2017**, 429-437.
9. Y. Deng, C. Sun, D.K. Hunt, C. Fyfe, C.L. Chen, T.H. Grossman, J.A. Sutcliffe, X.Y. Xiao, *J. Med. Chem*., **2017**, 60(6), 2498-2512.
10. S. Narsimha, K. Battula, N.V. Reddy, *Synth. Commun*., **2017**, 47(9), 928-933.
11. S.F. Ana, B. Luminita, Mol. Divers., 2017, 21(2), 437-454.
12. W. Wang, Y. Zhou, H. Peng, H. He, X. Lu, J. Fluor. Chem., **2017**, 193, 8-16.