

## A review on versatile applications of heterocyclic compounds

<sup>1</sup>Atul S. Kale and <sup>2</sup>Sachin S. Kale

<sup>1</sup>*Department of Chemistry, M.P.H. MahilaMahavidyalaya, Malegaon camp, (M.S.) India*

<sup>2</sup>*Department of Chemistry, A.C.S. College, Navapur, (M.S.) India*

### ABSTRACT:

Heterocyclic compounds have one or more hetero atoms in their structure. They may be cyclic or non-cyclic in nature. Heterocyclic compounds have wide range of application. The vital attention of the pharmaceutical and agrochemical industries in heterocycles is often connected with their natural occurrence. Heterocycles form considerably the main of conventional organic divisions of organic chemistry and are of huge importance biologically and industrially due to uniqueness in their structural Skelton parts. They are abundant in our surrounding and naturally found in nucleic acid, antibiotics, vitamins, hormones etc. Today there are a lot of heterocyclic compounds are known, day by day the number is increasing rapidly due to the huge synthetic research and also their synthetic utility. The present article provides versatile applications of heterocyclic compounds in medicinal and industrial field.

### INTRODUCTION

Heterocyclic compounds are of very much interest in our daily life. Heterocycles form by far the largest of classical divisions of organic chemistry and are of huge importance biologically and industrially. The majority of pharmaceuticals and biologically active agrochemicals are heterocyclic while numerous additives and modifiers used in industrial applications ranging from cosmetics, reprography, information storage and plastics are heterocyclic in nature. One striking structural features inherent to heterocycles, which continue to be exploited to great advantage by the drug industry, lies in their ability to manifest substituents around a core scaffold in defined three dimensional representations[1]. Heterocyclic chemistry is one of the most significant and important fundamental division of organic chemistry dealing with synthesis, properties, and applications of heterocycles. The Heterocyclic compounds are cyclic organic compounds that contain at least one hetero atom, the familiar hetero atoms are nitrogen, oxygen and sulphur and other variety of atoms including Se, P, Si, B hetero atoms are also widely known[2, 3].

Medicinal chemistry which is becomes significant field in chemistry because the joining between chemistry and the medical life issues by trying to study the common diseases and how should we solve it. This branch of the modern chemistry has been start when isolating and purifying active materials from plants and animals tissues and taken from microorganism and their fermentation products has become the focus of attention of researchers around the world. The medical chemistry based on the classical branches of chemistry especially organic chemistry and biology and some area of physics [4]. Heterocyclic compounds have attracted a significant interest for their highly electron-donating and strong coordination abilities, and still receive much attention because of their applications. Synthesis of secondary and tertiary amines through the *N*-alkylation of primary amine is the furthestmost important and essential reaction in synthetic chemistry. However, *N*-alkylation using alkyl halides is a traditional method of *N*-substituted amines synthesis [5].

Heterocyclic compounds involve a wide range of uses, including agrochemical, medicinal, and veterinary [6]. Such compounds are also used in dyestuff, sanitizers, copolymers, antioxidants, corrosion inhibitors, [7], *etc.* Heterocycles are currently employed in the production of a wide range of organic chemical substances [8]. Several compounds, mostly of natural origin, such as alkaloids, morphine, vinblastine, and reserpine, and a variety of antibiotics, such as cephalosporin, penicillin, and others, include heterocyclic components [9].

An important feature of the structure of many heterocyclic compounds is that it is possible to incorporate functional groups either as substituents or as part of the ring itself. For example, basic nitrogen

atoms can be incorporated both as amino substituents and as part of a ring. This means that the structures are particularly versatile as a means of providing, or of mimicking a functional group. For example the uses of tetrazole ring system [10].

### **MEDICINAL IMPORTANCE OF HETEROCYCLIC COMPOUNDS:**

Medicinal chemistry plays significant role in joining the chemistry and the medical life issues together. In the medicinal world, the chemistry of heterocycles with their intrinsic versatility and unique physicochemical properties has played a critical role in combating many deadly diseases. There are huge number of pharmacologically active heterocyclic compounds having application in many common diseases as herbicides, antimicrobial, urinary antiseptics and anti-inflammatory agents. Some heterocycles exhibit antibiotic, antitumor, antimalarial, anti-inflammatory, antidepressant, anti-HIV, antimicrobial, antifungal, antibacterial, antiviral, antidiabetic activity [11].

### **BIOLOGICAL IMPORTANCE OF HETEROCYCLIC COMPOUNDS:**

Heterocyclic compounds are widely spread in nature, crucial to life and playing vital role in the metabolism of all living cells. Heterocyclic compounds are broadly and economically valuable as therapeutic agents with high degree of structural diversity. Biomolecules as DNA, RNA, vitamins chlorophyll, various natural products, haemoglobin and biologically active compounds having herbicidal, fungicidal, and insecticidal activity contain the heterocyclic ring in key skeleton. They frequently found as a key structural unit in synthetic pharmaceuticals and agrochemicals. They are used as vehicles in the synthesis of other organic compounds. Some of the natural products e.g. antibiotics such as penicillin's, cephalosporin; alkaloids such as morphine, vinblastine, reserpine etc. have heterocyclic moiety. Many heterocyclic compounds are found as crucial components in biological processes [12].

### **ANTI-INFLAMMATORY ACTIVITY:**

Is a term referring to the substances that used to treatment or reduces inflammations or swelling. Analgesic makes up about half of anti-inflammatory drugs.

D. Li et al. [13] have isolated six compounds *Nauclea officinalis* (Pierre ex Pit.) and compared the activity of it. D.V. Sawhney and S.N.S. Bhutani [14] have prepared some novel 2-(2-benzothiazolyl)-6-aryl-4, 5-dihydro-3(2 H)-pyridazinone and found that they possessed low to moderate anti-inflammatory activity.

### **ANTIFUNGAL ACTIVITY:**

It is substances or medications that used to treat the fungal infection which is most commonly located on the skin, hair and nails. There are some common fungal infections such as ringworm and athlete's foot, etc. The effect of antifungal medicine either by killing the fungal cells due to affecting on the substances of the cell membrane which is lead to cells components leak out and cell die. Another way by preventing the growth and reproduction of the fungal cells.

C. Chitra et al. [15] have synthesized indole 3-acetic acid based biopolymeric hydrogels, this compounds also show activity against fungal infections and tested of several type of fungi including, *Aspergillus fumigates*, *Rhizopusoryzae* and *Candida albicans* at different concentrations using ketoconazole as positive control and Dimethyl Sulfoxide (DMSO) as negative control for antifungal activity. M. Molnar et al. [16] have synthesized a series of dipicolinic acid derivatives, some of it show antifungal activity against fungal strains called *Aspergillus flavus*, *Aspergillus ochraceus*, *Fusarium graminearum* and *Fusarium verticillioides*.

### **ANTIBACTERIAL ACTIVITY:**

Antibacterial or antibiotics is a term that used to describe the drugs which are used for prevention or treatment of bacterial infections, either by killing or inhibit the growth of bacteria. The antiprotozoal activity

also related to some of the antibiotics. Antibiotics do not effective against viral infections such as the common cold or influenza.

M.E. Azabet *al.* synthesized novel heterocyclic compounds with a sulfonamide moiety, such as aminopyrazole derivatives, pyrazolopyrimidine derivative, and pyrimidine and thiazine derivatives, and assessed them for their antibacterial efficacy. Most of the synthesized compounds exhibited promising antibacterial properties against Gram-positive and Gram-negative bacteria [17]. Y. Deng et al. [18] have synthesized a series of new derivatives of tetracyclines. 1,7-trifluoromethyl-8-pyrrolidinyltetracyclines as broad spectrum antibacterial agents with enhanced activity against *P. aeruginosa*. K. Iqbal et al. [19] have been synthesized some of N-substituted acetamide derivatives of azinane-bearing 1,3,4-oxadiazole nucleus derivatives and screening it is antibacterial activity against five types (*Salmonella typhi*, *Escherichia coli*, *P. aeruginosa*, *S. aureus* and *Bacillus subtilis*) of bacterial strains. All the synthesized compounds are moderate inhibitors but relatively more active against Gram-negative bacterial strains.

### ANTICANCER ACTIVITY:

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or Spread to the other parts of the body. This disease caused by varied agents such as, chemical compound, radiant energy. There are a lot of drugs which is used for treatment of this disease either by kill cancer cells or modify their growth.

Y. Liu *et al.* reported the synthesis of phenanthroindolizidine and phenanthroquinolizidine alkaloids for potential use as anticancer drugs with IC<sub>50</sub> values of 166 nM and 2.1 nM, respectively. The majority of synthesized compounds exhibited active proliferative action in opposition to BEL-7402 and A549 cells. In the primary screening, compound [20]. Y. Thigulla et al. [21] have been synthesized fused chromeno[4,3-b]pyrrolo [3,2-h]quinolin-7(1H)-one and test anticancer activity of the prepared compounds. S.A. Morsy et al. [22] have been synthesized new derivatives of coumarin containing compounds which showed anticancer activity by screened biologically against two human tumor cell lines, breast carcinoma Michigan Cancer Foundation-7 (MCF-7)

### ANTIDIABETIC ACTIVITY:

Diabetes Mellitus is a collection of metabolic disorders defined by a persistently high blood sugar level. The most prevalent symptoms of diabetes include increased appetite, increased thirst, and frequent urination.

P. Prabhat *et al.* [23] synthesized benzothiazole derivatives and explored their antidiabetic activity. In diabetic rats, the synthesized compounds caused a greater drop in blood glucose compared to other compounds. The LD<sub>50</sub> values of the synthesized compounds were estimated to be in the range of 100-1000 mg/kg, respectively. F. Panahiet *al.* [24] synthesized novel pyrimidine-fused hybrids with IC<sub>50</sub> values of 148±1 µM and 9±1 µM, respectively, as strong antidiabetic  $\alpha$ -glucosidase inhibitors. Both compounds displayed excellent inhibitory activity against yeast  $\alpha$ -glucosidase. In addition, compound also exhibited inhibitory activity against mouse  $\alpha$ -glucosidase.

### ANTIALLERGIC:

There are a lot of synthesized heterocyclic compound that showed anti allergic activity when tested [25]. Z. Zhang and B. Yu [26] have been synthesized anti allergic naphtho-r-pyrone Tetraglucoside, cassiaside C2, isolated from cassia seeds. E.J.M. Chem et al. [27] have been synthesized pteridinones and related compounds and the anti allergic activity was confirmed, It was therefore selected for further development as a human therapeutic agent, below one of the prepared compounds.

## ANTIOXIDANTS ACTIVITY:

Oxidation is the chemical reaction that can produce free radicals and cause cell damage by chain reactions. Antioxidant is molecules that inhibit oxidation reaction of other molecules such these compounds thiols or Ascorbic acid (vitamin C) can terminate these chain reactions and prevent cell damage.

E.A. Haidasz and D.A. Pratt [28] have synthesized diazaphenoxazines and diazaphenothiazines compounds which they are highly reactive radical trapping antioxidants. This activity was proved by preliminary kinetic studies. N. Jahan et al. [29] have been submitted their works which is include synthesis new derivatives of flavones and pyrazolines derived from chalcones. Tested of these compounds *in vitro* showed significant antioxidant activities were also shown by flavones and pyrazolines.

## CONCLUSION

Heterocyclic compounds one of the important kinds of organic compounds, which are taking a wide range in the medicinal chemistry this due to the huge number of heterocyclic compounds that used in medicine as drugs for varied diseases. Heterocyclic compounds are useful synthetic targets and key structural units in organic synthesis and medicinal chemistry because of their exciting biological activities. The drugs which contain the core of heterocyclic, its skeletons such as antifungal activity, anti-bacterial, anti-inflammation, antiallergic, antioxidants, anticonvulsant, herbicidal activity and anticancer, etc. Heterocyclic compounds are widely distributed in nature. By advantage of their therapeutic properties, they could be employed in the treatment of infectious diseases.

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