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HETEROCYCLIC COMPOUND AND IT'S IMPORTANCE

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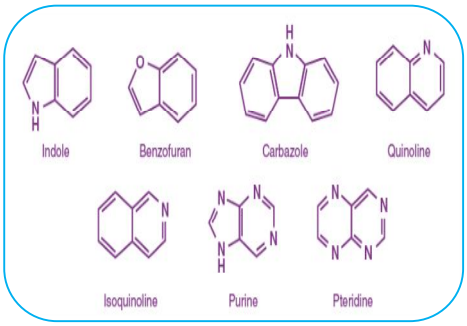
ABSTRACT

A heterocyclic compound or ring structure is a cyclic compound that contains atoms of at least two different elements as members of its ring. Heterocyclic chemistry is the branch of organic chemistry concerned with the synthesis, properties and applications of these heterocycles. Examples of heterocyclic compounds include all nucleic acids, most drugs, most biomass (cellulose and related substances), and many natural and synthetic dyes. More than half of known compounds are heterocycles. 63% of US FDA-approved drugs contain nitrogen heterocycles.



KEYWORDS: *Heterocyclic Compound, tetrahydrofuran, 1,2,3,4-tetrahydropyridine.*

INTRODUCTION

Usually, they are indicated as counterparts of carbocyclic compounds, which contain only ring atoms of a single element. Another classical reference book, Encyclopaedia Britannica, describes heterocyclic compounds, also called heterocycles. Although heterocyclic compounds can be inorganic, most contain at least one atom of carbon and one or more elements such as sulphur, oxygen, or nitrogen. Since non-carbons are generally considered to replace carbon atoms, they are called heteroatoms. The compounds may contain aromatic or non-aromatic rings. Heterocyclic chemistry is the branch of chemistry that deals with the synthesis, properties and applications of heterocycles.

Heterocyclic derivatives, seen as a group, can be divided into two broad areas: aromatic and non-aromatic. In the following figure, five-membered rings are shown in the first row, and the derivative 1 corresponds to the aromatic derivative, furan, while tetrahydrofuran (2), dihydrofuran-2-one (3), and dihydrofuran-2,5- Dione (4) are not aromatic, and their reactivity would not be unlike that expected of an ether, an ester, or a carboxylic anhydride, respectively. The second row shows six-membered rings, initially in an aromatic form as pyridine (5), while piperidine (6), piperidin-2-one (7), and 1,2,3,4-tetrahydropyridine (8) are not aromatic; their reactivity would not be very different from that expected of an amine, amide, or enamine, respectively. In general, the reactivity of aromatic heterocycles, which is a combination of that expected from an aromatic system combined with the influence of the heteroatoms involved, is usually more complex, while the reactivity of the non-aromatic systems is not too different from the usual non-cyclic derivatives. Heterocyclic derivatives, viewed as a group, can be divided into two broad categories: aromatic and non-aromatic. In the diagram below, five-

membered rings are shown in the first row, and derivative 1 corresponds to the aromatic derivative, furan, while tetrahydrofuran (2), dihydrofuran-2-one (3), and dihydrofuran-2,5-dione (4) are aromatic. are not present and their reactivity is not as expected for an ether, ester or carboxylic anhydride, respectively. The second row shows six-membered rings, initially in the aromatic form of pyridine (5), while piperidine (6), piperidin-2-one (7), and 1,2,3,4-tetrahydropyridine (8) do not. Aromatically their reactivity is not much different from that expected for an amine, amide or enamine, respectively. In general, the reactivity of aromatic heterocycles, combined with the effects of heteroatoms expected from aromatic systems, is usually more complex, while the reactivity of non-aromatic systems is not much different from that of non-cyclic derivatives.

Figure 1.1 Example of Heterocyclic Compound

GENERAL FEATURES OF HETEROCYCLIC COMPOUND:

The most common heterocycles are five- or six-membered rings and contain heteroatoms of nitrogen (N), oxygen (O), or sulfur (S). The most famous of the simple heterocyclic compounds are pyridine, pyrrole, furan, and thiophene. A pyridine molecule consists of a ring of six atoms - five carbon atoms and one nitrogen atom. Pyrrole, furan, and thiophene molecules each have five-membered rings, composed of four carbon atoms and one atom of nitrogen, oxygen, or sulfur, respectively. Rings Many biological molecules contain pyridine and pyrrole rings, and such substances yield small amounts of pyridine and pyrrole when heated strongly. In fact, both of these substances were discovered in the 1850s in an oily mixture made by strongly heating the bones. Today, pyridine and pyrrole are produced by synthetic reactions.

Their main commercial interest is in their conversion into other substances, mainly pigments and drugs. Pyridine is also used as a solvent, waterproofing agent, rubber additive, alcohol denaturant and dyeing aid. Furan is an oxygenated heterocycle that is primarily used for conversion to other substances (including pyrrole). Furfural, a close chemical relative of furan, is obtained from oat hulls and corncobs and is used in the production of intermediates for nylon. Thiophene, a sulfur heterocycle, resembles benzene in its chemical and physical properties. It is a frequent contaminant of benzene obtained from natural sources and was first discovered during the refining of benzene. Like other compounds, it is primarily used for conversion into other substances. Both furan and thiophene were discovered in the late 19th century.

Heterocyclic Chemistry deals with heterocyclic compounds which constitute about sixty-five percent of the organic chemistry literature. Heterocyclic compounds are widely distributed in nature and abundant in life; They play an important role in the metabolism of all living cells. The genetic material DNA ia also composed of heterocyclic base-pyrimidines and purines. A large number of heterocyclic compounds, both synthetic and natural, are pharmacologically active and in clinical use. Heterocyclic compounds have a wide range of applications: they are prominent in a variety of compounds used as pharmaceuticals, agrochemicals, and veterinary products. They also find applications as sensitizers, developers, antioxidants, corrosion inhibitors, copolymers, pigments. They are used as vehicles in the synthesis of other organic compounds. Some natural products e.g. Antibiotics such as penicillin, cephalosporin; Alkaloids like vinblastine, morphine, reserpine etc. have a heterocyclic moiety. One reason for the widespread use of heterocyclic compounds is that their structure can be

subtly manipulated to achieve the desired change in function. Many heterocycles fit into one of a few broad groups of cab designs that share overall similarities in properties but vary significantly within groups. Such differences may include differences in acidity or basicity, different polarities. Possible structural differences include substituting one heteroatom for another ring and different positions of the same heteroatom in the ring.

An important feature of the structure of many heterocyclic compounds is that functional groups can be incorporated either as subgroups or as part of the ring itself. For example, a basic nitrogen atom can be incorporated as an amino element and as part of a ring. This means that structures are particularly versatile as a means of providing or mimicking a functional group. For example, the tetrazole ring system is used as a carboxylic and functional group mimic because of its similarity in acidity and steric requirements. The tetrazole group is superior in terms of metabolic stability, bioavailability, and the four nitrogen atoms in the tetrazole ring can create a more charge distribution.

Another example, octanol can be used to mimic the amphiphilic nature of lipids, as it has a polar head group (primary alcohol) and a long hydrocarbon chain as a tail, such as the OH fatty acids that form part of lipid membranes. Armed with this understanding, organic chemists can tailor structures to meet specific needs by modifying the heterocyclic moiety. Heterocyclic compounds are also finding increasing use as intermediates in organic synthesis. Often this is because a relatively stable ring system can be carried through several synthetic steps and then cleaved at the required stage of the synthesis to reveal other functional groups. For eg. 4-Chloro-5(4H)- oxazolones are useful intermediates in organic synthesis. In particular, hydrolytic cleavage gives α-chloro-αacylaminoketones. They are logical intermediates for the formation of 4(phosphoranylidene)- 5(4H)-oxazolones, which are very important and useful ligands. Some sterically congested 'roofed' 2-thiazolines as new chiral ligands for Cu(II)-catalyzed asymmetric diesalder reactions lead to excellent endo/exo ratios and endo-enantioselectivities compared to the corresponding chiral 'roofed' 2-oxazoline ligands. Heterocyclic compounds are widely distributed in nature. Many are of fundamental importance to living systems: it is surprising how often heterocyclic compounds are found as key components in biological processes. For example, nucleic acid bases, which are derivatives of purines, ie adenine, guanine and pyrimidines, ie thymine, cystosine are important for the mechanism of replication. Some purines and pyrimidines can act as antibiotics by interfering with DNA synthesis. Puromycin is an example of such an antibiotic.

HETEROCYCLIC FROM MARINE SOURCE:

Marine invertebrates are the source of many novel, natural products, having no terrestrial equivalent or similarity. More than 18,000 compounds appear in the 2006 MarineLit database. In the 1960s and 1970s, due to the extraction techniques applied, most isolated compounds were isoprenoids and polyketides, compounds containing N-atoms ("alkaloids"), mainly isolated from sponges and ascidians, only became more common in later years. The latter group includes many new bioactive heterocycles that have no terrestrial counterparts. Representative new heterocycles isolated by us from Red Sea and Indo-Pacific sponges, tunicates and some soft corals are shown. All depicted new compounds exhibit unique structures, some of which exhibit interesting bioactivities, for example, the antiviral activity of ptilomycalin A, the actin-binding activity of latrunculin, and the cytotoxicity of pyridoacridines, elatin, and norsegoline.

CONCLUSION:

The rate at which heterocyclic compounds are being discovered testifies to the strength and vitality of this field of organic chemistry. The challenges of discovering new heterocyclic systems and understanding their properties are also driving research in this area.

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