Libyan International
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PYRROLE, THIOPHENE AND FURAN

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Objectives:

01

Identify Pyrrole, furan and Thiophene

02

Explain the physical and chemical properties of Pyrrole, furan and Thiophene

03

Discuss the medicinal importance of pyrrole, furan and thiophene

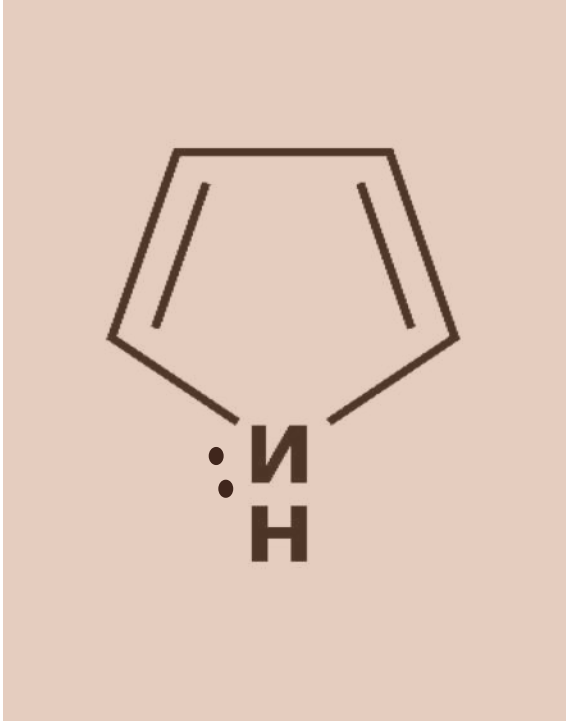
INTODUCTION

five membered Heterocyclic compounds contain one heteroatom.

- The most common heterocycles are those having five membered rings containing heteroatoms of Nitrogen (N), Oxygen(O), Sulphur(S).
- They obey Hickel's rule and are aromatic compounds
- The six pie electrons are provided from the 4sp^2 carbon atoms and the lone pair of electrons of the sp^2 heteroatoms.

01

PYRROLE

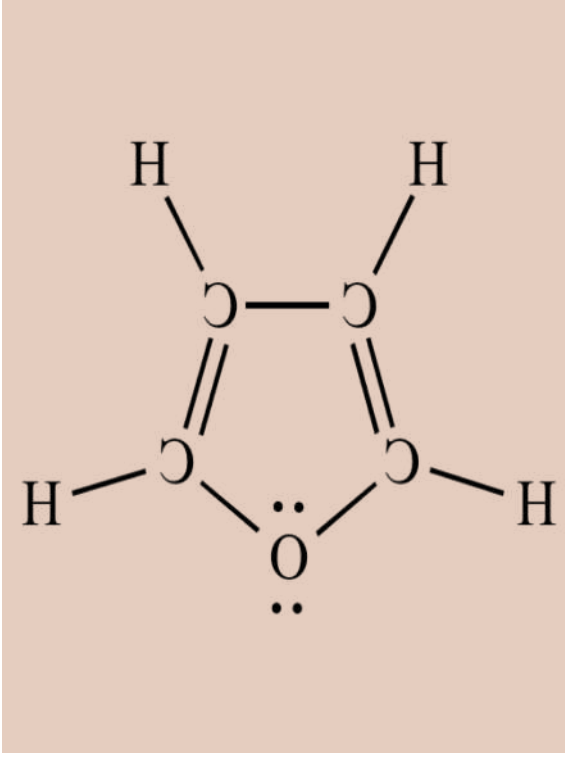


- **Pyrrole** is a nitrogen-containing unsaturated five-membered heterocycle aromatic compound with the formula C_4H_4NH. It shows aromaticity by delocalization of a lone pair of electrons from nitrogen.
- The pyrrole derivatives alkaloids are found in plants like Opium, coffee and also found in marine.
- Pyrrole is found in collagen as proline and hydroxyproline.

02

FURAN

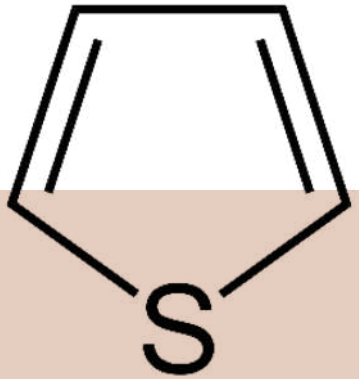
- **furan**, is an oxygen-containing five-membered aromatic heterocyclic compound, with the formula **C4H4O**
- The highly electronegative oxygen holds on the electron density tightly.
- Although it has a lone pair of electrons, these electrons cannot delocalize easily, and so the system is generally considered to be almost non-aromatic or weakly aromatic
- furan is produced through thermal degradation of natural food constituents.



03

THIOPHENE

- **Thiophene** is a Sulphur-containing five-membered unsaturated heterocycle, with the formula C_4H_4S
- Thiophene is considered less aromatic than benzene.
- The thiophene ring is present in many important pharmaceutical products.
- The sulfur heterocyclic thiophene are found in petroleum derivatives.
- The most important biologically thiophene is found in biotin.

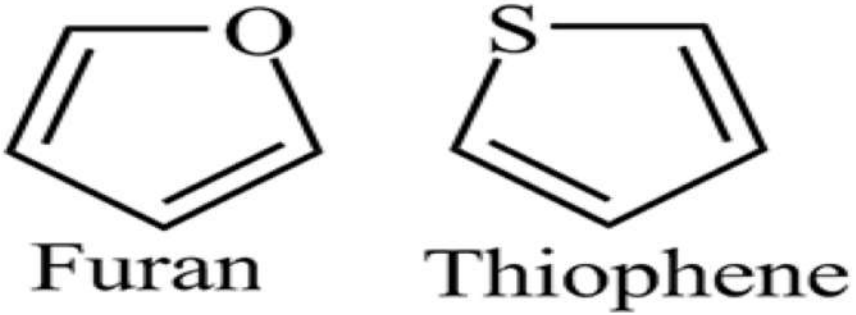


EXPLAIN THE PHYSICAL PROPERTIES OF PYRROLE, FURAN AND THIOPHENE

- **Pyrrole** is a colorless volatile liquid that darkens readily upon exposure to air. The Boiling point of pyrrole is 129 to 131 °C The Melting point −23 °C. Pyrrole has a nutty odour Pyrrole is weakly basic, Acidity (pKa): 16.5 pyrrole is less soluble in water because it forms intramolecular hydrogen bond within it's own molecules but Also soluble in most organic solvents

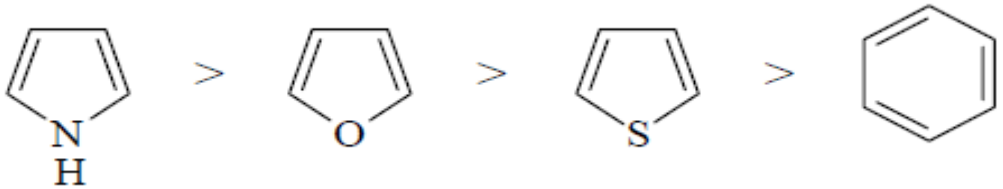
- **Thiophene** appears as a colorless liquid with an unpleasant odor. Insoluble in water and slightly denser than water. Thiophene possesses a mildly pleasant odour The boiling point of thiophene is 84 ºC. The Melting point is −38 °C. Thiophene insoluble but soluble in organic solvent. more reactive than benzene.

- **furan** is a colorless, flammable, highly volatile liquid . It is soluble in common organic solvents, but insoluble in water . a boiling point close to room temperature (31.4 ºC) the melting point of furan is −85.6 °C Its odor is "strong, ethereal; chloroform-like"



CHEMICAL PROPERTIES

- The aromatic five-membered heterocycles all undergo electrophilic substitution, with a general reactivity order: pyrrole >> furan > thiophene > benzene. Some examples are given in the following diagram. The reaction conditions show clearly the greater reactivity of furan compared with thiophene. All these aromatic heterocycles react vigorously with chlorine and bromine,

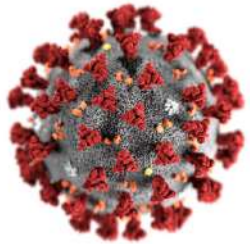


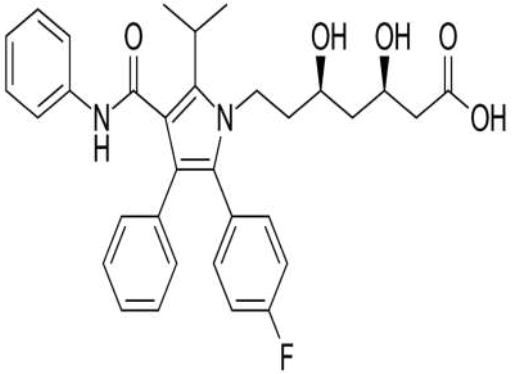
DISCUSS THE MEDICINAL USE OF PYRROLE, FURAN AND THIOPHENE

Pyrrole , **furan** and **thiophene** are heterocyclic compound plays most important role in the field of clinical therapeutics. It shows wide range of activities for medication purpose , having significant antihypertensive activity., Significant antineoplastic , Non-steroidal, anti-inflammatory drug and antibacterial properties.

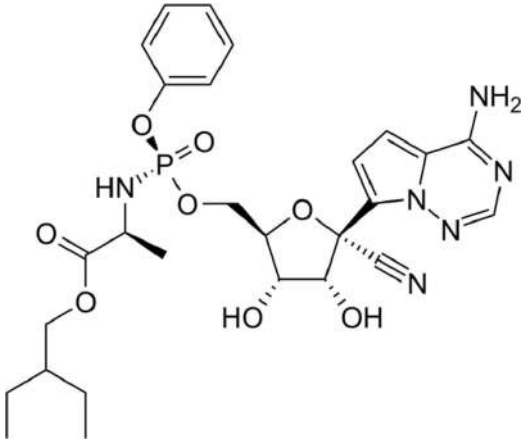
MEDICINAL USE OF PYRROLE

- Pyrroles are found in several drugs, including atorvastatin, ketorolac
- Atorvastatin is used along with a proper diet to help lower "bad" cholesterol and fats.
- Among these, the antiviral agent remdesivir, which is nowadays in clinical trials as promising drug for the treatment of patients affected by COVID-19..





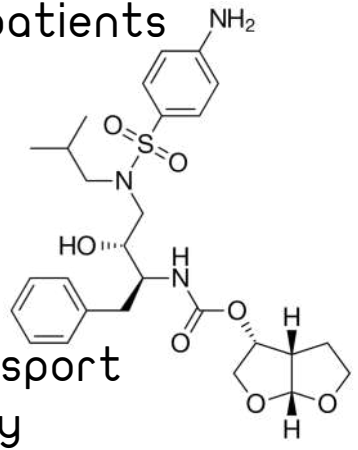
Atorvastatin



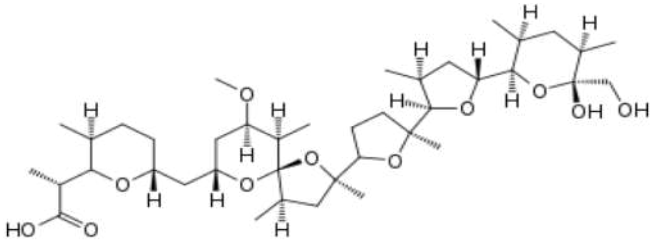
remdesivir

MEDICINAL USE OF FURAN

Darunavir : A HIV protease inhibitor used in the treatment of human immunodeficiency virus (HIV) infection in patients with history of prior antiretroviral therapie.



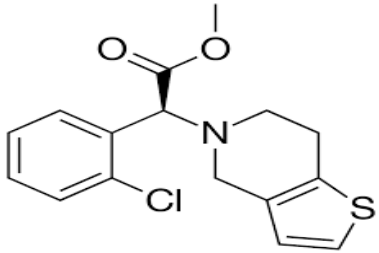
Nigericin polyether antibiotic which affects ion transport and ATPase activity in mitochondria. It is produced by Streptomyces hygroscopicus. (from Merck Index, 11th ed)



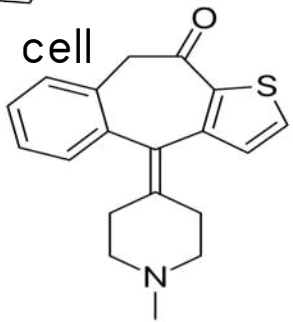
MEDICAL USE OF THIOPHENE

Thiophene derivatives show high antimicrobial activity against various microbial infections.

Clopidogrel An antiplatelet agent used to prevent blood clots in peripheral vascular disease, coronary artery disease, and cerebrovascular disease.



Ketotifen : A histamine H1 receptor blocker and mast cell stabilizer used to treat mild atopic asthma and allergic



SUMMARY

- Pyrrole, furan and thiophene are organic compounds. These are five-membered ring structures in which one carbon atom is replaced with a different group such as an amine group, an oxygen atom or a sulfur atom
- These heterogeneous compounds exist in several forms in nature
- Pyrrole furan and thiophene color less liquids , have different boiling point ,melting point , and different odour.
- Pyrrole, furan and thiophene more reactive then aromatic compound , they undergo electrophilic substitution reaction.
- These compounds undergo in medical uses as drugs constitutes.

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THANKS