MEDICINAL CHEMISTRY 3

UNIT – 1

Antibiotics

Historical Background:

- The discovery of antibiotics dates back to the early 20th century.
- Sir Alexander Fleming's discovery of penicillin in 1928 is considered a landmark event.
- The Golden Age of Antibiotics (1940s-1960s) witnessed the discovery of various classes of antibiotics.

Nomenclature:

- Antibiotics are named based on their chemical structure, source, or function.
- The suffix "-cillin" is commonly used for penicillins, "-mycin" for macrolides, "-cycline" for tetracyclines, etc.

Stereochemistry:

- Stereochemistry is crucial in antibiotics' activity, as enantiomers or diastereomers may exhibit different pharmacological properties.
- Certain antibiotics have chiral centers, and the specific stereochemistry is essential for their biological activity.

Structure-Activity Relationship (SAR):

- SAR studies help understand how the chemical structure of antibiotics influences their pharmacological activity.
- For β-Lactam antibiotics, the presence of the β-lactam ring is crucial for activity against bacterial cell walls.
- In Aminoglycosides, the amino sugar residues and their arrangement contribute to antibacterial activity.
- Tetracyclines' activity depends on the structure of the four fused rings and the specific functional groups attached.

Chemical Degradation:

- Antibiotics may undergo chemical degradation due to factors like heat, light, or pH changes.
- Proper storage and handling are crucial to maintain their stability and efficacy.

Classification and Important Products:

β-Lactam Antibiotics:

1. **Penicillins:**
    - **Structure:** β-lactam ring + thiazolidine ring.
    - **Important Products:** Penicillin G, Penicillin V, Amoxicillin, Ampicillin.
2. **Cephalosporins:**
    - **Structure:** Similar to penicillins but with a dihydrothiazine ring.
    - **Important Products:** Cephalexin, Ceftriaxone, Cefotaxime.
3. **β-Lactamase Inhibitors:**
    - **Examples:** Clavulanic acid, Sulbactam, Tazobactam.
    - **Function:** Used in combination with β-lactam antibiotics to inhibit β-lactamase enzymes, enhancing their effectiveness.
4. **Monobactams:**
    - **Example:** Aztreonam.
    - **Distinctive Feature:** Contains only one β-lactam ring, making it structurally unique.

Aminoglycosides:

1. **Streptomycin:**
    - **Source:** Streptomyces bacteria.
    - **Activity:** Effective against Gram-negative bacteria.
2. **Neomycin:**
    - **Source:** Streptomyces bacteria.
    - **Application:** Topical use due to potential toxicity.
3. **Kanamycin:**
    - **Source:** Streptomyces bacteria.
    - **Usage:** Treatment of severe infections.

Tetracyclines:

1. **Tetracycline:**
    - **Structure:** Four-ring structure.
    - **Application:** Broad-spectrum antibiotic.
2. **Oxytetracycline:**
    - **Source:** Produced by Streptomyces rimosus.
    - **Usage:** Treatment of various infections.

3. **Chlortetracycline:**
    - **Structure:** Tetracycline derivative.
    - **Application:** Veterinary medicine.
4. **Minocycline:**
    - **Semi-synthetic derivative of tetracycline.**
    - **Usage:** Effective against a wide range of bacteria.
5. **Doxycycline:**
    - **Semi-synthetic derivative of tetracycline.**
    - **Features:** Longer half-life, convenient dosing.

This overview provides a comprehensive understanding of antibiotics, their historical context, nomenclature, stereochemistry, structure-activity relationships, chemical degradation, and important products within the specified classes.