

7.1.1. Introduction

The word **antibiotic** was derived from the word **antibiosis** which means **against life**. Historically, antibiotics were believed to be organic compounds produced by a microorganism toxic to other microorganisms. Due to this belief, an antibiotic was initially defined as a substance produced by a microorganism, which can prevent the growth of, or are fatal to other microorganisms even at low concentrations. But this definition has been modified at the present time for including antimicrobials produced by synthetic means either partially or wholly.

Antibiotics can either kill other bacteria or inhibit their growth. Those antibiotics which kill bacteria are termed as bactericidal and those which inhibit bacterial growth are termed bacteriostatic. Even though antibiotics are referred to as antibacterial agents, still they are differentiated as antibacterials, antifungals, and antivirals to indicate the type of microorganisms against which they act.

7.1.2. Classification

Antibiotics can be classified as follows:

1) Based on their Chemical Structure

i) Antibiotics

- a) **β -Lactam Antibiotics:** Penicillins, Cephalosporins, Monobactams, Carbapenems etc.
- b) **Aminoglycosides:** Streptomycin, Gentamycin, Framycetin, Neomycin, etc.
- c) **Macrolide Antibiotics:** Erythromycin, Roxithromycin, Clarithromycin, Azithromycin, etc.
- d) **Tetracyclines:** Oxytetracycline, Doxycycline, Minocycline, etc.
- e) **Nitrobenzene Derivatives:** Chloramphenicol, etc.
- f) **Polypeptide Antibiotics:** Polymyxin-B, Colistin, Bacitracin, Tyrothricin, etc.
- g) **Polyene Antibiotics:** Nystatin, Hamycin, Amphotericin-B, etc.
- h) **Miscellaneous Agents:** Rifampicin, Lincomycin, Vancomycin, Fusidic acid, Cycloserine, Viomycin, Griseofulvin, etc.

ii) Chemotherapeutic Agents Other than Antibiotics

- a) **Sulphonamides and Related Agents:** Sulfadiazine, Sulfamethoxazole, Sulfones (Dapsone), *Para*-Aminosalicylic Acid (PAS), etc.

- b) **Diaminopyrimidines:** Pyrimethamine.
- c) **Quinolones and Fluoroquinolones:** Nalidixic acid, Norfloxacin, Ciprofloxacin, Ofloxacin, etc.
- d) **Nitrofuran Derivatives:** Nitrofurantoin, Furazolidone, etc.
- e) **Nitroimidazoles:** Metronidazole, Tinidazole, etc.
- f) **Imidazole Derivatives:** Miconazole, Clotrimazole, Ketoconazole, Fluconazole, etc.
- g) **Nicotinic Acid Derivatives:** Isoniazid, Pyrazinamide, Ethionamide, etc.
- h) **Miscellaneous Agents:** Ethambutol, Thiacetazone, Clofazimine, etc.

Based on their Mechanism of Action

- i) **Inhibit Cell Wall Synthesis:** Penicillins, Cephalosporins, Cycloserine, Vancomycin, and Bacitracin.
- ii) **Cause Leakage from Cell Membranes:** Polypeptides (Polymyxins, Colistin, and Bacitracin) and Polyenes (Amphotericin B, Nystatin, and Hamycin).
- iii) **Inhibit Protein Synthesis:** Tetracyclines, Chloramphenicol, Erythromycin, Clindamycin, and Linezolid.
- iv) **Cause Misreading of m-RNA Code and Affect Permeability:** Aminoglycosides (Streptomycin, Gentamicin, etc.).
- v) **Inhibit DNA Gyrase:** Fluoroquinolones (Ciprofloxacin, etc.).
- vi) **Interfere with DNA Function:** Rifampin and Metronidazole.
- vii) **Interfere with DNA Synthesis:** Acyclovir and Zidovudine.
- viii) **Interfere with Intermediary Metabolism:** Sulphonamides, Sulphones, PAS, Trimethoprim, Pyrimethamine, and Ethambutol.

Based on their Range of Action

- i) **Broad Spectrum Antibiotics:** These are effective against gram +ve and gram -ve bacteria, rickettsia, and chlamydia e.g., Tetracycline, Chloramphenicol etc.
- ii) **Relative Broad Spectrum Antibiotics:** These are effective against gram +ve and gram -ve bacteria e.g., Ampicillin group, Cephalosporins, Rifamycins, etc.
- iii) **Narrow Spectrum Antibiotics**
 - a) These are effective against gram +ve bacteria, e.g., Penicillin, Erythromycin group, and Vancomycin.
 - b) These are effective against gram -ve bacteria, e.g., Streptomycin and other aminoglycoside antibiotics, Colistin, Polymyxin-B.
 - c) **Antifungal Antibiotics:** Hamycin, Nystatin, Griseofulvin, etc.
 - d) **Anticancer Antibiotics:** Actinomycin, Bicomycin, Mitomycin, Mithramycin, etc.

Based on Types of Organisms Against which Primarily Active

- i) **Antibacterial:** Penicillins, Aminoglycosides, Erythromycin, etc.

- ii) **Antifungal:** Griseofulvin, Amphotericin B, Ketoconazole, etc.
- iii) **Antiviral:** Acyclovir, Amantadine, Zidovudine, etc.
- iv) **Antiprotozoal:** Chloroquine, Pyrimethamine, Metronidazole, Diloxanide, etc.
- v) **Anthelmintic:** Mebendazole, Pyrantel, Niclosamide, Diethylcarbamazine, etc.

5) Based on their Type of Action

- i) **Primarily Bacteriostatic:** Sulphonamides, Erythromycin, Ethambutol, Tetracyclines, Chloramphenicol, and Clindamycin Linezolid.
- ii) **Primarily Bactericidal:** Penicillins, Aminoglycosides, Cephalosporins, Vancomycin, Nalidixic acid, Polypeptides, Ciprofloxacin, Rifampin, Isoniazid, Pyrazinamide, Metronidazole, and Cotrimoxazole.

6) Based on their Source

- i) **Fungi:** Penicillin, Griseofulvin, and Cephalosporin.
- ii) **Bacteria:** Polymyxin B, Tyrothricin, Colistin, Aztreonam, and Bacitracin.
- iii) **Actinomycetes:** Aminoglycosides, Macrolides, Tetracyclines, Polyenes, and Chloramphenicol.