Antibiotic Production

One microorganism's production of a chemical known as an antibiotic prevented the growth of other bacteria. However, this definition has changed since the development of synthetic techniques, and an antibiotic is now defined as a material produced by a microorganism or a similar material (produced entirely or in part by chemical synthesis) that, at low concentrations, prevents the growth of other microorganisms. An early example was Chloramphenicol.

In 1929, Alexander Fleming discovered penicillin almost accidentally , and the medical use came during the 1939-1945.

Antibiotics are frequently used to refer to antimicrobial substances that are made exclusively synthetically, such as sulphonamides and 4-quinolones.

Vuillemin define antibiosis (literally “against life”) as the biological concept of survival of the fittest, in which one organism destroys another to preserve itself. The word antibiotic was derived from this root. The use of the term by the lay public, as well as the medical and scientific communities, has become so widespread that its original meaning has become obscured.

In 1942, Waksman3 proposed the widely cited definition that “an antibiotic or antibiotic substance is a substance produced by microorganisms, which has the capacity of inhibiting the growth and even of destroying other microorganisms. "Later proposals have sought both to expand and to restrict the definition to include any substance produced by a living organism that is capable of inhibiting the growth or survival of one or more species of microorganisms in low concentrations.

Therefore, a substance is classified as an antibiotic if the following conditions are met:

1. It is a product of metabolism (although it may be duplicated or even have been anticipated by chemical synthesis).
2. It is a synthetic product produced as a structural analog of a naturally occurring antibiotic.
3. It antagonizes the growth or survival of one or more species of microorganisms.
4. It is effective in low concentrations.

-Antibiotic: This term was used to describe substances produced by microorganisms that could be used to kill or inhibit growth of certain other microbes .

- Antibiotic: Any substance that can destroy or inhibit the growth of bacteria and similar microorganisms.

- Antibiotics: are the secondary metabolites of microorganisms.

Secondary metabolites (SMs) are natural products synthesized mainly by bacteria, fungi and plants. They are molecules of low molecular weight with diverse chemical structures and biological activities. The name secondary metabolite originates from the initial observation that their production is not necessary for the growth and reproduction of organisms, in contrast to primary metabolites which include lipids, amino acids, carbohydrates and nucleic acids. The synthesis of secondary metabolites is very dependent on the culture conditions, particularly the composition of the medium.

Commercial and scientific interest in the antibiotic field has led to the isolation and identification of antibiotic substances that may be numbered in the thousands. Numerous semisynthetic and synthetic derivatives have been added to the total. Very few such compounds have found application in general medical practice, however, because in addition to the ability to combat infections or neoplastic disease, an antibiotic must possess other attributes.

First, it must exhibit sufficient selective toxicity to be decisively effective against pathogenic microorganisms or neoplastic tissue, on the one hand, without causing significant toxic effects, on the other.

Second, an antibiotic should be chemically stable enough to be isolated, processed, and stored for a reasonable length of time without deterioration of potency. The amenability of an antibiotic for oral or

parenteral administration to be converted into suitable dosage forms to provide active drug in vivo is also important.

Third, the rates of biotransformation and elimination of the antibiotic should be slow enough to allow a convenient dosing schedule, yet rapid and complete enough to facilitate removal of the drug and its metabolites from the body soon after administration has been discontinued. Some groups of antibiotics, because of certain unique properties, have been designated for specialized uses, such as the treatment of tuberculosis (TB) or fungal infections. Others are used for cancer chemotherapy.

- Microbicidal: The substances were used to kill the other microbes.

- Microbistatic: The substances were used to inhibit or retard growth of microorganisms.

- The antibiotic action depend on :

a) The concentration of antibiotics.

b) Type of bacteria: Gram positive (G+) bacteria are more sensitive to antibiotics

c) than Gram negative (G-) bacteria .

The effectiveness of an antibiotic is described as :

- Broad spectrum : when it acts on a wide range of (G+ve) and (G-ve) bacteria
- Narrow – spectrum antibiotics: are more specific , these can be useful
- medically because they target a limited range of microbes .

The mechanism of action of antibiotics :

1) Interference with cell – wall synthesis (in bacteria) .
2) Interference with membrane function (in fungi).
3) Protein synthesis.
4) Nucleic acid synthesis.

COMMERCIAL PRODUCTION

Antibiotics are produced industrially by a process of fermentation, where the source microorganism is grown in large containers (100,000 – 150,000 liters or more) containing a liquid growth medium.

The commercial production of antibiotics for medicinal use follows a general pattern, differing in detail for each antibiotic. The general scheme may be divided into six steps:

(a) preparation of a pure culture of the desired organism for use in inoculation of the fermentation medium;

(b) fermentation, during which the antibiotic is formed;

(c) isolation of the antibiotic from the culture medium;

(d) purification;

(e) assays for potency, sterility, absence of pyrogens, and other necessary data; and

(f) formulation into acceptable and stable dosage forms.

Antibiotic resistance:

Antibiotic resistance can be defined as the acquired ability of microorganisms to resist the effects of an antibiotic to which it is normally susceptible.

Some organisms are naturally resistant , whereas others may developed and acquired by genetic mutation (conjugation) transduction or transformation in bacteria .