Antibiotic Production

- In 1929 , Alexander Fleming discovered penicillin almost accidentally , and the medical use came during the 1939-1945.
- Antibiotic : This term was used to describe substances produced by microorganisms that could be used to kill or inhibit growth of certain other microbes .
- Microbicidal : The substances was used to kill the other microbes.
- Microbistatic : The substances was used to inhibit or retard growth of other microorganisms .
- The antibiotic depend on :

a) The concentration of antibiotics .

b) Type of bacteria : Gram positive (g+) bacteria are more sensitive to antibiotics than Gram negative (g-) bacteria .

The effectiveness of an antibiotic is described as :

- Broad spectrum : when it acts on a wide range of (g+) and (g-) 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 :

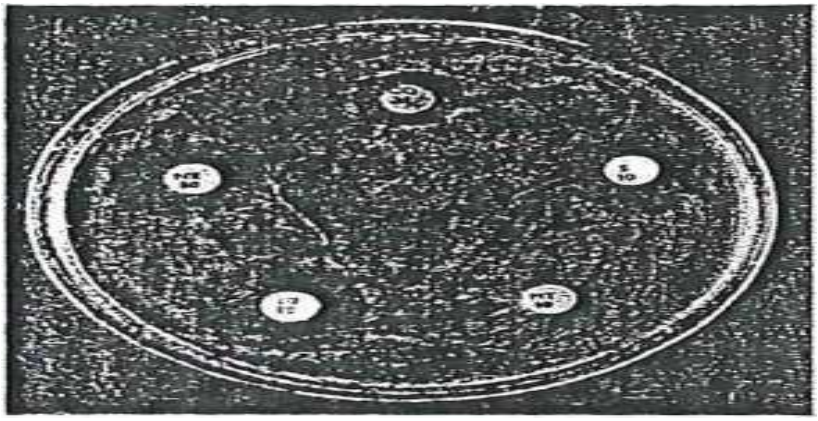
1) Interference with cell – wall synthesis , (in bacteria) .
2) Interference with membrane function , (in fungi) .
3) Protein synthesis .
4) Nucleic acid synthesis .

Commercial Sources :

Penicillium notatum, Penicillium chrysogenum .

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 .



An antibiotic sensitivity test. The agar plate has been streaked with a culture of E. coli and sensitivity discs, impregnated with antibiotics, placed on the agar. After incubation, clear inhibition zones are seen around discs which contain antibiotics to which the organism is sensitive. No inhibition zone is seen around the disc containing metbicillin, showing resistance to this antibiotic

Microbes for biological control

Microbial pathogens can thus be exploited as biological control agents, and success has been achieved using bacteria, fungi and viruses. The term microbial insecticide is used when the microorganism is used to control insects, and the term mycoherbicide when pathogenic fungi arc used to control weeds. While only a few mycoherbicides are currently being used commercially, it is an area where further research may be successful in providing alternatives to chemical herbicides for weed control.

A well established example of a microbial insecticide is Bacillus tburingiensis. This bacterium produces a glycoprotein, known as Bt, which is toxic to a variety of insects, such as butterflies ,moths and beetles, but not to animals and humans. When ingested by the insect larvae, the toxin leads to paralysis or degeneration of the gut. The insect is usually killed within a few hours.

Maize and resistance to pests

Maize is used for boil) human and animal food and may be processed to provide flour, oil, syrups or other food ingredients. The European Corn Borer (ECB) is an insect pest which destroys around 4 per cent of maize crops on a global scale and up to 20 per cent in some regions. The pest causes damage by boring through the stem and ear of the maize plant, which then falls over.

Genetically modified maize has been produced which shows resistance to pests. The pest-resistant maize produces a lethal protein when attacked by the insect. The gene for this toxic protein comes from Bacillus tburingiensis, which is already used widely in biological control. This protein is toxic to a variety of insects but not to animals or humans.

Rice and resistance to disease

Rice is a very important crop on a global scale, but suffers from the rice stripe virus (RSV). Transgenic rice, produced by introducing the gene for the virus protein coat into the rice plant genome, shows noticeably increased resistance to the rice stripe virus.

Microbes for biological control

- Microbial insecticide : is used when the microorganisms is used to control insects :
- Myco herbicide : pathogenic fungi are used to control weeds .
- Commercial source : *Bacillus thuringiensis*

Bt : A glycoprotein produces from the bacteria (*B. thuringiensis* : which is toxic to variety of insects . such as butterflies moth and beetles , but not to animals and humans .

Microbial mining:

Some bacteria are useful in extracting metals from low-grade ores. This is because they are chemoautotrophic. which means they derive their energy from inorganic chemicals. Bacteria of the genus Thiobacillus are used commercially to extract copper and uranium from otherwise uneconomic reserves. Cobalt, lead and nickel may also be extracted in this way in the near future. The extraction process may require extremes of environmental conditions, such as pH and temperature. Genetic engineering is being used to confer acid and heat resistance on these organisms.

Thiobacillus ferrioxidens, can oxidise insoluble chalcopyrites or ($CuFeS_2$) and convert it to the soluble salt Copper Sulphate. Sulphoric acid is produced during the process, yet the organism is able to flourish in these highly acidic conditions Copper can be extracted by reacting the copper Sulphate with iron. This method is responsible for about 25% of the copper produced in the USA.

$$CuFeS_2 + 2Fe_2(SO_4)_3 + 2H_2O + 3O_2 \longrightarrow CuSO_4 + 5FeSO_4 + 2H_2SO_4 + \text{energy}$$

$$CuSO_4 + Fe \longrightarrow Cu + FeSO_4$$

Uranium and copper are not the only metals which can be mined using bacteria (Thiobacillus ferrioxidans). In Brazilian, Australian and south Africa gold mines, microorganisms are used to treat the raw ore before final processing with cyanide to extract the metal.