

Antibacterials

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Antibacterials/Antibiotics

= Drugs that prevent the growth of, or kill, microorganisms that cause infectious diseases.

These drugs are **selective**, they are ineffective against normal body cells.

Microorganisms = single celled life forms capable of independent life if given a required amount of nutrients.

Infectious diseases = Occur when the body's natural defenses are ineffective due to 1) lack of natural immune system against infection.

2) too many microorganisms for the body's immune system to overcome.

3) rapid growth of the microorganisms.

Infectious Agents

There are two types of infectious agents:

- Bacteria
- Viruses

Antibiotics are ineffective against viruses since they are incapable of combating normal body cells.

Antibiotics aid white blood cells by

1. Preventing bacteria from multiplying
2. Preventing cell division (bacteriostatic drugs)
3. Directly killing Bacteria (bacteriocidal drugs)

Examples of bacterial infections: tetanus, tuberculosis (TB), cholera, etc.

Examples of Viral infections: influenza, common cold, hepatitis, etc.

History of Penicillins

1890s: Found out that certain fungi killed bacteria.

1928: **Alexander Fleming** finds out that the mold *penicillium notatum* prevented the growth of the bacteria *staphylococcus aureus*.

1940: **Florey and Chain** used penicillin on mice.

1941: Penicillin used for the first time on a human being.

1943: Penicillin available clinically.

1945: Fleming, Florey and Chain receive Nobel prize.

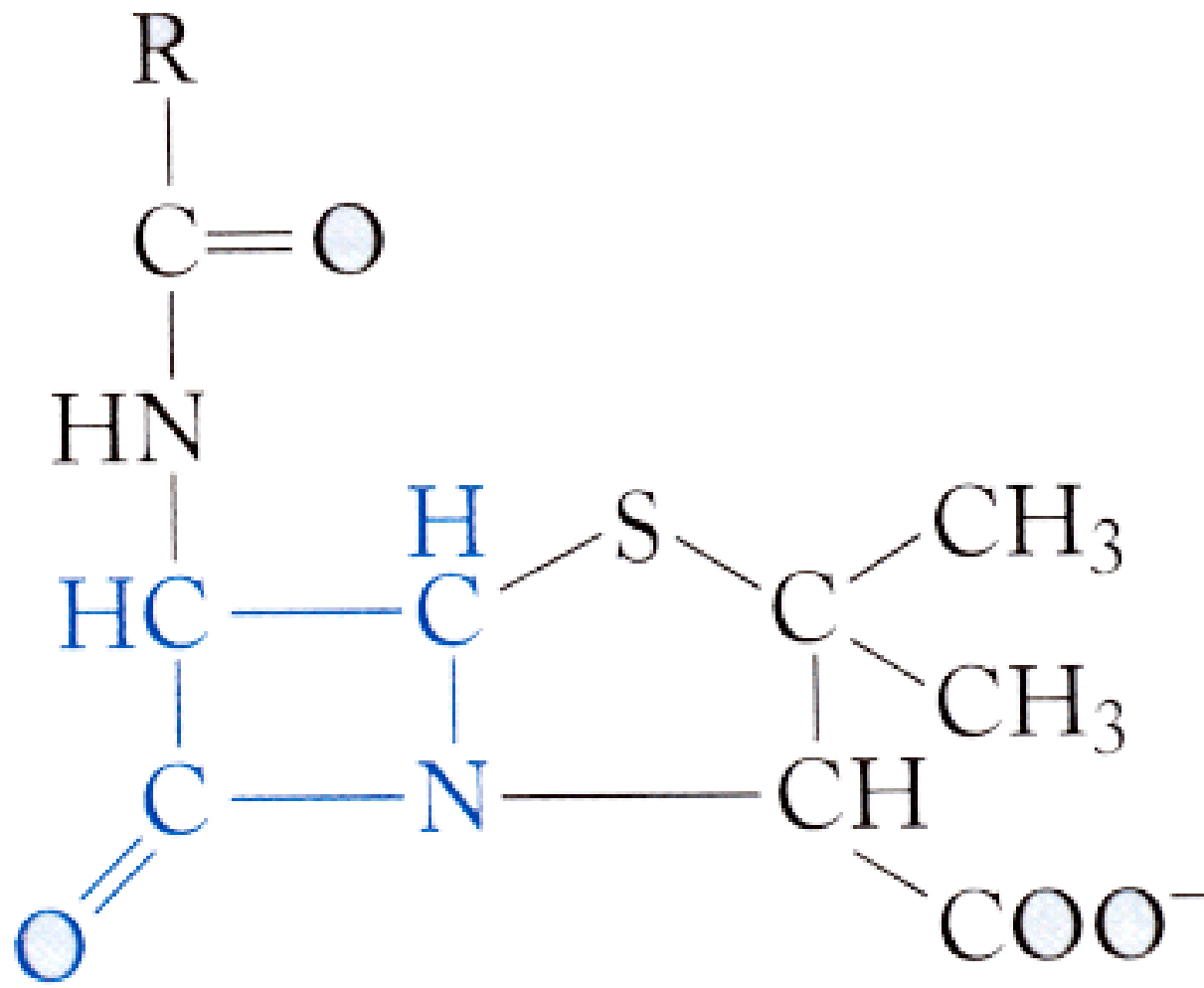




Alexander Fleming, a
bacteriologist

Florey and Chain
renewed Fleming's
research





Penicillin

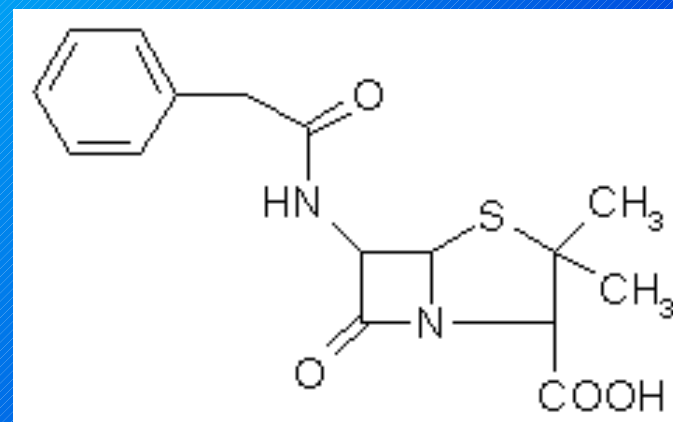
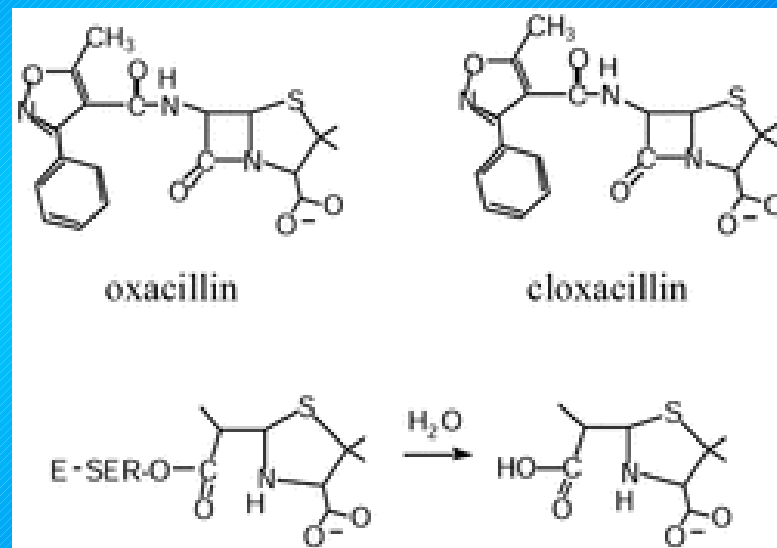
Structure of Penicillin

▶ Penicillin G (first penicillin used):
deactivated by 1) stomach acid \rightarrow
injected into body. 2) Penicillinase, an
enzyme created by bacteria

Penicillin V: acid resistant penicillin created
by modifying side chains.

Active penicillin: Aminopenicillanic acid, 6
APA, (common in all penicillins) and a
sidechain:

- $C_6H_5-CH_2$: benzyl penicillin or penicillin G
- $C_6H_5-CH_2-CH_2-$: penicillin V
- Cloxacillin, effective against penicillinase
and acid.



Penicillin G

Spectrum of Antibiotics

Broad spectrum antibiotics = one that is effective against a wide variety of bacteria. Examples:

- Ampicillin
- Tetracyclines such as Aureomycin and Terramycin. 'Mycin' is the suffix used for antibiotics obtained from soil fungi.

Repeated use:

- 1) wipes out harmless bacteria
- 2) wipes out helpful bacteria such as those in the Oesophagus, stomach and large intestines.
- 3) destroyed bacteria may be replaced by harmful ones.

Narrow spectrum Antibiotics

= the antibiotics effective against only certain types of bacteria.

Most penicillins (and sulfa drugs) are narrow spectrum antibiotics.

Treatment of infection:

Ideally bacterium should be identified before prescribing antibiotic. But this takes time so first a broad spectrum antibiotic is given and then a narrow spectrum one.



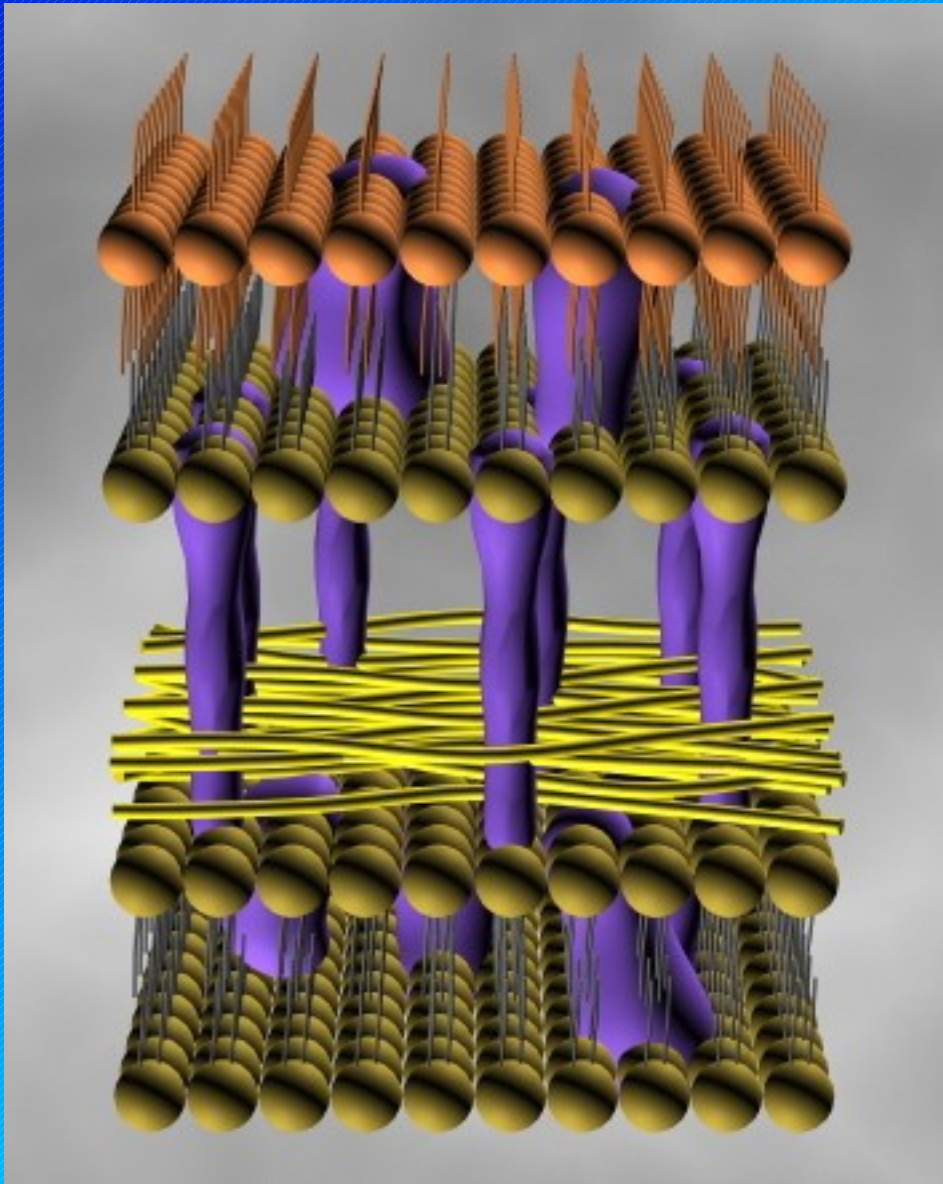
Bacteriocidal Drugs

Bacteria have cell walls mainly composed by polysaccharides that protects their cell structure and inside components. These cell walls are strong due to the chemical **cross-links**.

How does it work?:

1. Penicillins interfere with cell wall construction of bacteria.
2. The cross links are destroyed, hence weakening the cell walls.
3. Bacteria is unable to hold its size and shape.
4. Water enters by osmosis, the cell expands and bursts
5. Bacteria is killed by this.

Bacterial cell walls



Disadvantages of Penicillin Use

1. Small percentage of the population (10%) experience allergic reactions and other side effects such as body rash.
2. If used repeatedly, it may wipe out harmless or helpful bacteria. In addition these bacteria that are wiped out may be replaced by harmful bacteria.
3. Genetic resistance of bacteria. If antibiotics are used extensively some bacteria survive and pass on their immunity to next generations. Such examples are Typhoid, Gonorrhoea and Malaria.

A microorganism may become resistant as a result of mutation. A mutated bacteria may produce an enzyme that makes antibiotics ineffective.

Result of these mutations: Need for constant renewal of antibiotics.

Hence, antibiotics should only be used when no other treatment is effective.

Use of Antibiotics

Antibiotics are used to control animal diseases and to increase the rate of their growth (increase production).

This is done by adding antibiotics to the animal feedstock which can contain animal pathogens which are dangerous to animals and humans.

As before mentioned, if bacteria are extensively exposed to antibiotics they can develop an immune system that allows them to spread and reproduce quickly. Such are Salmonella and E.Coli that are not killed in animal feedstock

Hence, is it wise to use routine addition of antibiotics to animal livestock?

The End