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Popular Article

Applications of Bacteriophage

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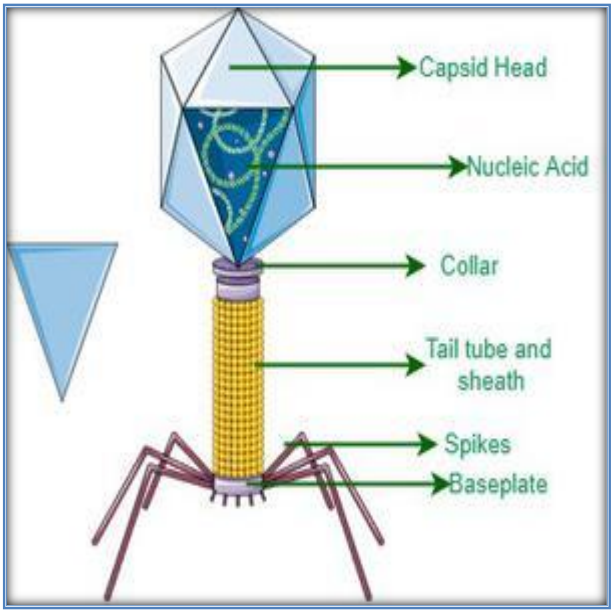
Introduction

The traditional culture system has shifted towards intensive culture systems, which facing a major challenge in the view of disease out beaks. Most of the bacterial infections in the culture systems were cured by the application of antibiotics. However, the uncontrolled usage of antibiotics resulting in the development of antibiotic resistance and spread to the humans. Hence, alternative for the application of antibiotics in aquaculture systems are the bacteriophages.



Bacteriophage structure

Phages:

The viral particles or its virion components that infect bacteria are known as phages or bacteriophages. These are the most prevalent biological entities in the biosphere, estimated to be ten times more numerous than the bacterial population. Bacteriophages are the virion particles which

consist of a nucleic acid (ds or Ss RNA or DNA), capsid (2000 capsomeres), tails (24 annular rings.) or spicules.

Discovery of Phages:

William Twort was first discovered bacteriophages in the year of 1915 and Felix d'Herelle in the year of 1917. They found that bacteriophages are working against the bacteria and then they started research on a number of model phages which primarily infected *E. coli*.

Principles of phages

Bacteriophages are intracellular parasites. They multiply in bacteria using some or all of the h os biological machinery**.** They enter bacterial cells by attaching to the cell wall and injecting their DNA into the bacterial cytoplasm. After penetration, the phage serves as a template for making phage proteins. These proteins allow the phage to replicate and conquer the cell, ending the death of t he host cell. Bacteriophage particles are more difficult to detect than bacteria. Viruses are beyond the resolution limits of light microscopes and can only be seen with an electron microscop.

Fortunately, we can use a method very similar to the colony count method used to measure ba cterial counts to count phage particles, called signal analysis.

Bacteriophages Characteristics:

Bacteriopages having number of features which can helps in the killing of bacteria efficiently. The following are the characteristics of bacteriophages:

1. Durability within the environment
2. Infect multiple bacteria or specific strains
3. Phage replication cycles
4. Bacteriophages functions in nature

1. Durability within the environment: Because of their structure and composition, bacteriophages may endure both natural and artificial pressures for an extended period of time. These phages are mostly infecting enteric bacteria which can better in the environment than their host bacteria.

2. Infect multiple bacteria or specific strains Phages can infect a wide spectrum of bacteria, which means it can kill both Gram positive and Gram-negative bacteria or be extremely specific to select groups or infecting just certain strains of the same bacterial species. This is determined by the receptors expressed on the host's cell surface, on which the phage binds and initiates infection.

3. Phage replication cycles: Generally, phages have two life cycles: lytic and lysogenic. Lytic cycle: Phages will take around 30 min to complete the lytic cycle. In this life cycle phages enter into host cell (infection) then phages grow vigorously followed by damaging g the host cell wall, revealing a

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progeny of 10–1000 individuals depending on the phage and the bacterium's physiological condition. Whereas in the lysogenic cycle, initially the phage injects its DNA, which is integrated into the bacterial genome (prophage) and replicates together with it.

Lytic Cycle stages:

In the Lytic Cycle, a bacteriophage infects a bacterium and kills it to release progeny virus. This cycle takes place in the following steps:

1. Adsorption: The bacteriophage attaches to the bacterial cell wall which is known as adsorption. The tail fibres of viral particles help in attachment with the specific receptors on the surface of the bacterial cell.

2. Penetration: After attachment, the phage muramidase weakens the cell wall and the hollow core is pushed downwards through it. Then thengenetic material of virus i.e DNA /RNA is injected in to the bacterial cell.

3. Synthesis of Phage Components: After genetic material releasing, the new virus particles are produced into the cell. The sub-units of phage head, tail and late protein then appear. The synthesis is carried out by specific enzymes called early proteins.

4. Maturation and Assembly: In this stage, the head and tail protein of phage DNA assemble and each component of phage DNA is surrounded by a protein coat. Ultimately, the tail structures are added forming a virion.

5. Release* or *Budding: From the infected bacterial cell, progeny phages are released after the cell wall lysis. The phage enzymes weaken the cell wall of bacteria during replication.

Lysogenic Cycle

In this, the prophage is transmitted to progenies at the time of cell division during reproduction in bacteria. Here the bacteria carrying a prophage without being lysed is called lysogenic bacteria. When the lysogenic bacteria multiply, the prophage might be lost due to excision.

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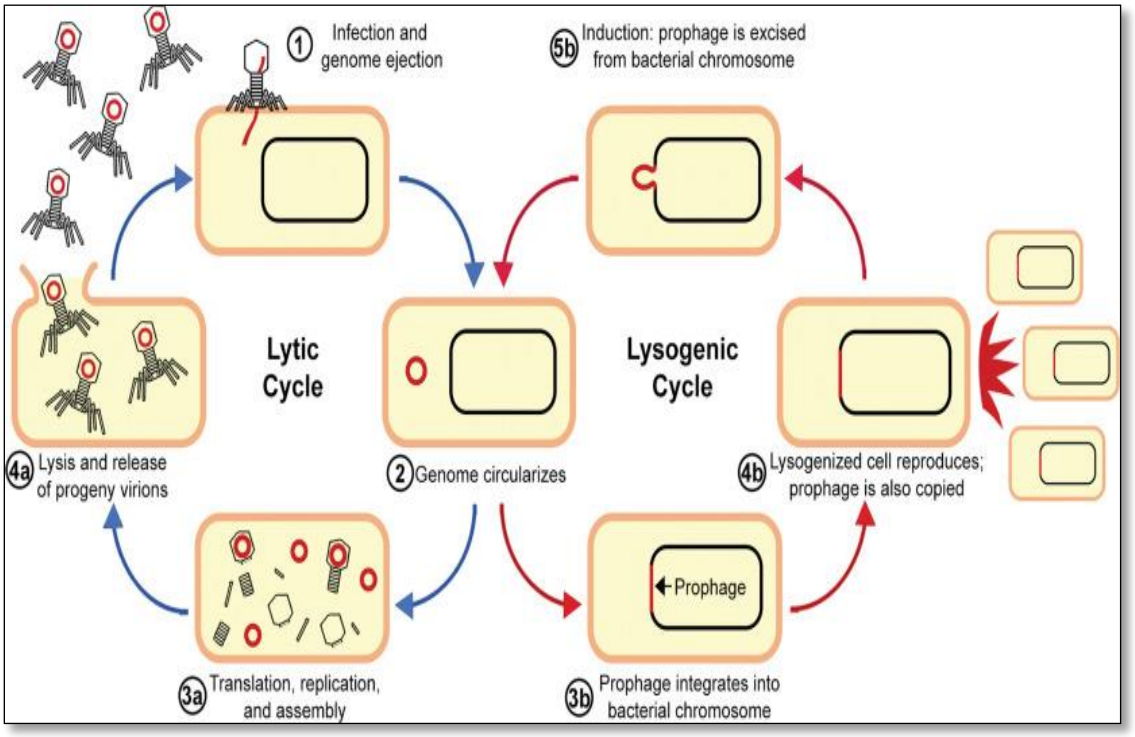


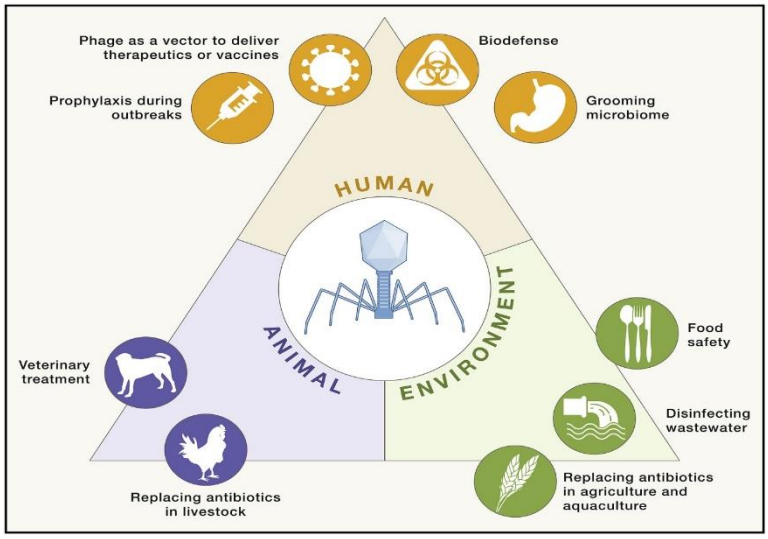
Bacteriophage life cycle

4. Bacteriophages function in nature:

The nature healthy environment concern, phages play major roles. For example, they can help in recycling of organic matter in the biosphere and control the loads of microbial diversity. At the laboratory level, they also play multiple roles as models and molecular tools in phage typing of bacterial strains, phage therapy applications, evolutionary models, and indicators of fecal contamination. The word bacteriophage referred as "bacteria eater". Hence, it is suggesting that bacteriophages can act as phagocytes, it can eat the bacteria.

Applications of phage therapy:

The bacteriophages having wide advantages and were used in various sectors. Following the advancement in phage therapy, it has been applied in areas such as treating bacterial infections and wounds, in cosmetics, reduce antibiotic usage, decrease AMR formation, destroy multiple drug resistant bacteria, alter



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the efficiency of the treatment process, preventing biofilms on medical devices, as an anti-tumor, in veterinary medicine.

The application of phage therapy instead of antibiotics to eliminate pathogenic bacteria such as *Vibrio*, *Pseudomonas*, *Aeromonas*, and *Flavobacterium* and to reduce fish mortality in aquaculture has been frequently reported.

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