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Paper: II, Group-'A'

Topic: Genetic Recombination in Bacteria (Conjugation).

Lecture no. 19

Genetic Recombination in Bacteria continued (Transduction):

(3). Transduction:

It is a special method of genetic recombination where genetic material is transferred from the donor to the recipient cell through a non-replicating bacteriophage or temperate bacteriophage. This was discovered by Joshua Leaderberg and Nortor Zinder (1952) during their research with Salrv onella typhimurium.

In this process, a small fragment of bacterial DNA is incorporated into an attacking bacteriophage (i.e., virus which infects bacteria) and when this bacteriophage infects a new bacterial cell, it transfers the genetic material into it, and thus genetic recombination takes place.

Transduction is of two types:

A. Specialized transduction, and

B. Generalized transduction.

A. Specialised Transduction:

In this process, the bacteriophage gets attached to a bacterial cell wall at the receptor site and the nucleic acid of bacteriophage is transferred into the cytoplasm of the host cell (Fig. 2.32A). The phage does not cause the lysis of the host bacterium. In the bacterial cell, the phage nucleic acid codes for the synthesis of specific proteins, the repressor proteins.

The repressor proteins prevent the virus to produce the material require for its replication. In the bacterial cell, the viral DNA may exist as a fragment in the cytoplasm or it may attach itself to the chromosome, known as prophage (Fig. 2.32B). The bacterial cell which carries the prophage is called lysogenic and the phenomenon where the phage DNA and bacterium exist together is called lysogeny.

The bacterial cell may remain lysogenic for many generations and during this period the viral DNA replicates many times together with the bacterial chromosome.

However, in course of time, the phage stops the synthesis of repressor proteins in the bacterial cell, and then the synthesis of phage components starts. Now the phage DNA separates from the bacterial chromosome and starts the synthesis of phage proteins (Fig. 2.32C).

During this separation, a number of genes of the bacterium get attached to it. These attached genes keep on replicating along with the phage DNA (Fig. 2.32D) and later on it develops into phage particles, those come out from the bacterial cell by bursting (Fig. 2.32E).

When the new phage particle (Fig. 2.32F) infects a new bacterial cell (Fig. 2.32G, H), the attached bacterial genes present along with phage particle enters in the chromosome of the new bacterium and causes recombination (Fig. 2.321).

Thus the new bacterial cell contains its own genes and several genes from the parent bacterial cell. This type of transduction is known as specialised transduction, which is an extremely rare event.

B. Generalised Transduction:

This process of transduction is more common than specialized transduction. Here the prophage particle is present in the cytoplasm of the infected bacterial cell (Fig. 2.32J). In this process, the phage DNA starts synthesizing new phages.

During this process chromosome of bacterial cell gets fragmented (Fig. 2.32K) and some of the fragments become attached with the DNA of some new phage particle, while others remain with phase DNA (Fig. 2.32L).

When the newly formed phage with fragment of bacterial chromosome in its DNA (Fig. 2.32M) attacks a new bacterium, the gene of the parent bacterium is transferred to the new bacterium and causes recombination. This type of transduction is called generalized transduction. This type of transduction is also rare.

Diagram to show the detailed mechanism of Tansduction:

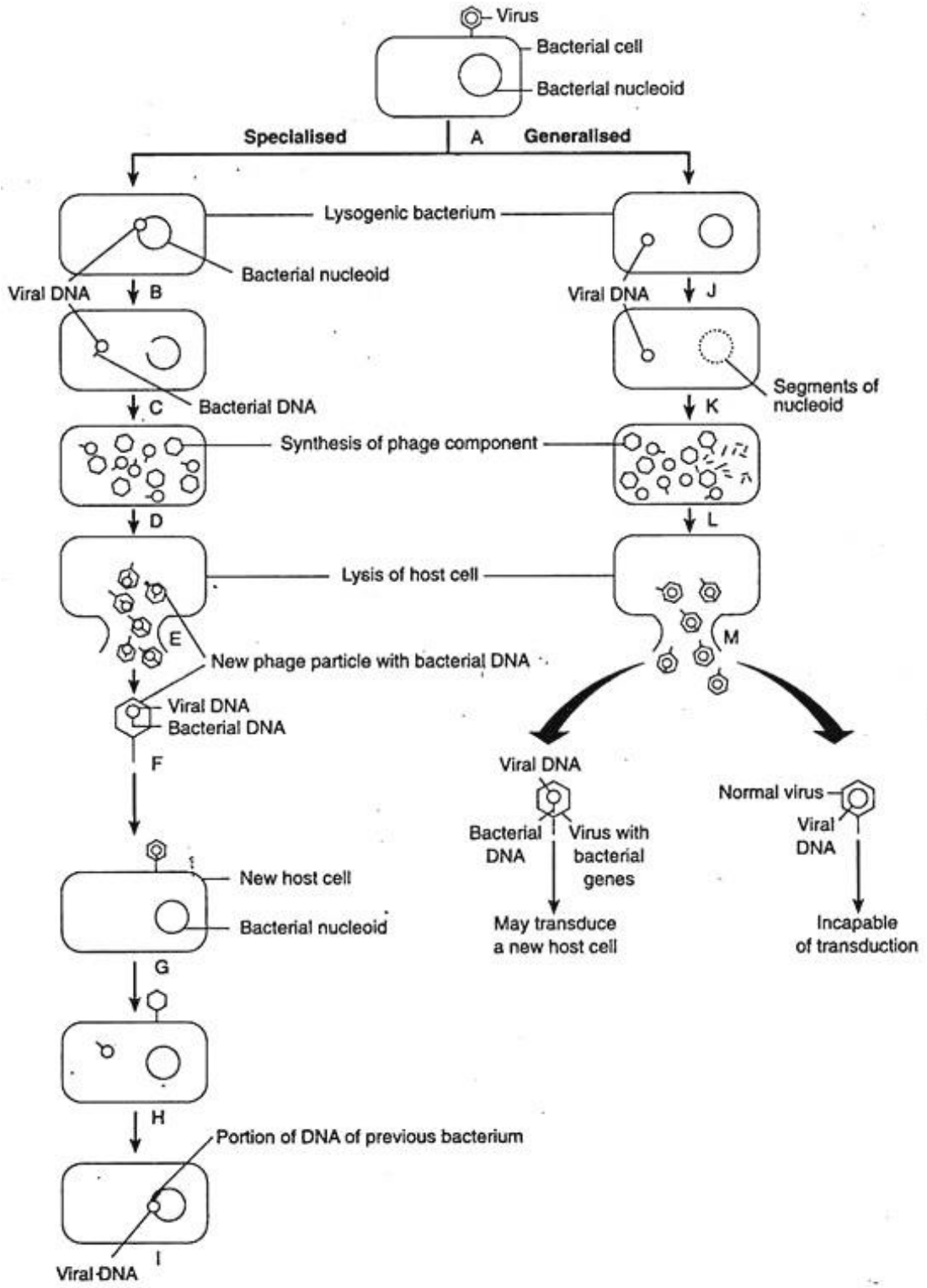

Fig. 2.32 : Diagrammatic representation of Transduction