Difference Between Bacterial Transposases and Retroviral Integrases

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Key Difference - Bacterial Transposases vs Retroviral Integrases

The transportable genetic material has evolved with two major strategies to move from one region to the next region of within and between the genomes. One method is to displace through an RNA molecule before the formation of a DNA molecule whilst the other pathway involves DNA intermediates. Transposases and viral integrases are examples of such transposable genetic material. **Bacterial transposases bind to the end of transposons and facilitate the catalysis of the transposon movement to another part of the genome through various mechanisms. Retroviral integrases are enzymes that assist in the integration of the genetic material of retrovirus such as HIV into the genetic material (DNA) of the host cell it infects.** This is the **key difference** between bacterial transposases and retroviral integrases.

What are Bacterial Transposases?

Transposase can be defined as an enzyme bound to the end of transposons that facilitate the catalysis of the transposon movement to another part of the genome through various mechanisms. Such mechanisms include 'cut and paste mechanism' and 'replicative transposition mechanism'. Transposase was first introduced through the cloning of the enzyme which is needed for the transposition of the Tn3 transposon. Two important strategies have been utilized by the transposable genetic elements for the displacement between genomes or from one site to another. The transport through an intermediate of RNA before the synthesis of a DNA copy is one strategy while the other is being bound to DNA intermediates alone. The recombination reactions which are involved in the integration of both elements are taken place due to element- specific enzymes. Thus, in an instance of DNA elements, these enzymes are known as transposases while in an instance of RNA elements, they are known as integrases.

When comparing the differences between both the transposition strategies, the process of insertion is appeared to be identical chemically. But, recent evidence proposes that the certain similarities in integration mechanism are seen in the regions of amino acid sequences that forms an active site; the DDE motif. Five families of transposases are being classified at present but, the number of families is yet to increase with new transposase characters. The families include DDE transposase, Tyrosine (Y) transposase, Serine (S) transposase, Rolling circle transposase, Reverse transcriptases/endonucleases (RT/En) etc. These families utilize unique catalytic mechanisms for the breaking and rejoining of DNA. The DDE transposase involves in the cut and paste mechanism of the original transposon and carries three sets of conserved amino acids namely; aspartate (D), aspartate (D) and glutamate (E). The tyrosine transposases also involve in the cut and paste mechanism by the utilization of tyrosine residue, which is site-specific.

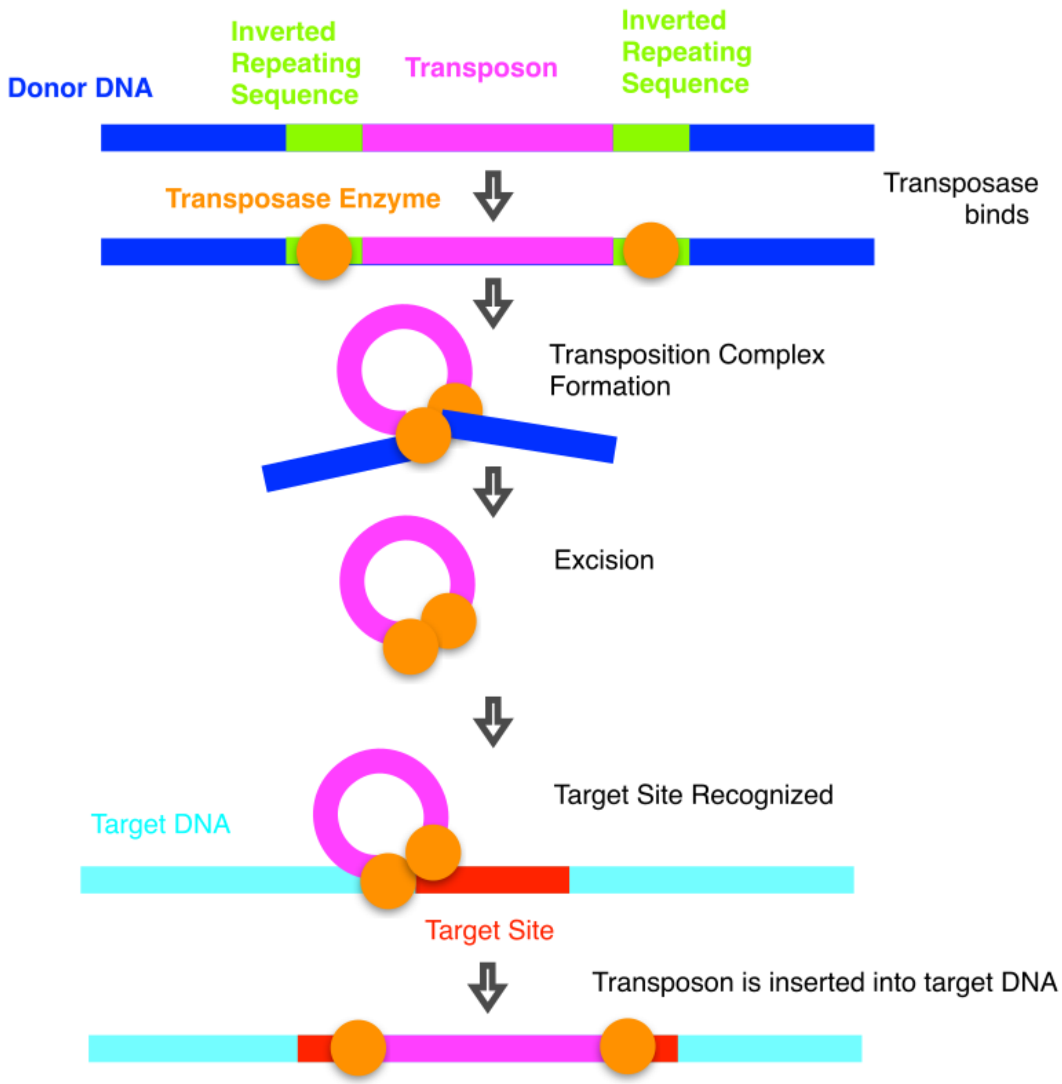

Figure 01: Bacterial Transposases

The serine transposases involve an intermediate of circular DNA and carry out the cut and paste mechanism just as above families. The rolling circle transposase involve in the copy- in mechanism where a single strand is directly copied into the target site through DNA replication. This ensures that the template strand and the copied strand have a strand which is newly synthesized. The reverse transcriptases/endonucleases transposase has various mechanisms for transposition.

What are Retroviral Integrases?

In the context of Retroviral Integrase, it is considered as a retroviral enzyme that assists in the integration of the genetic material of retrovirus such as HIV into the genetic material (DNA) of the cell which is infected. These retroviral integrases most often get confused with phage integrases. Examples for phage integrases are λ phage integrase. But these are completely different enzymes and should not get confused with. In respect to the formation of retroviral pre-integration complex, retroviral integrase plays a major role. Retroviral integrase proteins typically consist of three (03) canonical domains. These domains are connected by flexible linkers.

The three domains include an N terminal zinc-binding domain where three helical bundles are connected and stabilized through coordination with the involvement of a Zn^{2+} cation, an RNase H fold catalytic core domain and a C terminal DNA binding domain, which is an SH3 fold. By investigation and through biochemical and structural information, it suggests that retroviral integrase has the ability to function as a dimer of dimmers (tetramer). In the context of multimerisation and viral DNA binding, all three domains of the retroviral integrase protein. The major function of retroviral integrase is to insert its genetic material to host DNA. This step is the most crucial step in viral replication of HIV virus. Once successfully integrated, it will be there in the chromosomal DNA of the cell for the rest of its lifespan.

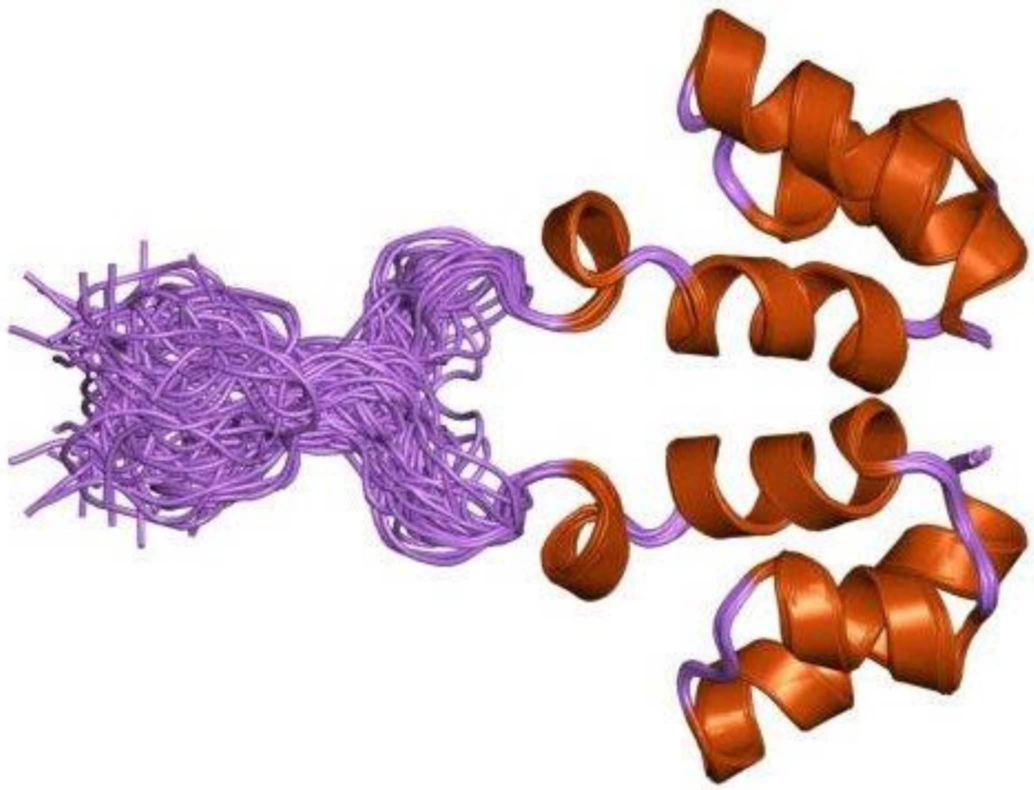

Figure 02: Retroviral Integrases

Therefore, once integrated there is no return for the cell. These retroviral integrases involve in the catalyzing of two major reactions including 3' end processing and covalent ligation. During 3' end processing, 2-3 nucleotides from both 3' ends of the viral DNA are removed with the intention of revealing the CA dinucleotides of the 3' ends of the viral DNA, and during covalent ligation, the processed 3' ends of viral DNA are ligated covalently into the host chromosomal DNA.

What is the Similarity Between Bacterial Transposases and Retroviral Integrases?

- Both Bacterial Transposases and Retroviral Integrases have similar amino acid sequences.

What is the Difference Between Bacterial Transposases and Retroviral Integrases?

Bacterial Transposases vs Retroviral Integrases	
Bacterial Transposase is an enzyme bound to the end of transposons while facilitating the catalysis of the transposon movement to another part of the genome through various mechanisms.	Retroviral Integrases is considered as a retroviral enzyme that assists in the integration of the genetic material of retrovirus such as HIV into the genetic material (DNA) of the cell that is infected.
Binding Regions	
High specific binding regions are needed for Bacterial Transposases.	Less or no nucleotide sequence for binding.

Summary - Bacterial Transposases vs Retroviral Integrases

Bacterial transposases are considered as a retroviral enzyme that assists in the integration of the genetic material of retrovirus such as HIV into the genetic material (DNA) of the cell which is infected. Two important strategies have been utilized by the transposable genetic elements for the displacement between genomes or from one site to another. Five families of transposases are being classified at present but, the number of families is yet to increase with new transposase characters. Retroviral Integrase, it is considered as a retroviral enzyme that assists in the integration of the genetic material of retrovirus such as HIV into the genetic material (DNA) of the cell that is infected. Retroviral integrase proteins typically consist of three (03) canonical domains. The major function of retroviral integrase is to insert its genetic material to host DNA. This step is the most crucial step in viral replication of HIV virus. Therefore, once integrated there is no return for the cell. This is the difference between Bacterial transposases and Retroviral Integrase.

Reference:

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Image Courtesy:

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