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Editorial

Reverse Transcriptase: An Enzyme to Generate Complementary DNA

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EDITORIAL NOTE

A Reverse Transcriptase (RT) is an enzyme that reverses transcription by converting an RNA template into complementary DNA (cDNA). Viruses like HIV and hepatitis B use reverse transcriptases to replicate their genomes, retrotransposon mobile genetic elements use reverse transcriptases to proliferate within the host genome, and reverse transcriptases are used by eukaryotic cells to stretch the telomeres at the ends of their linear chromosomes. Contrary to popular assumption, the procedure does not violate the traditional core dogma's description of genetic information flows, because information transfers from RNA to DNA are specifically allowed. RNA-dependent DNA polymerase activity, ribonuclease H (RNase H), and DNA-dependent DNA polymerase activity are the three biochemical actions of retroviral RT. These functions combine to allow the enzyme to convert single-stranded RNA to double-stranded cDNA. This cDNA can then integrate into the host genome, from which additional RNA copies can be produced by host-cell transcription in retroviruses and retrotransposons. In the laboratory, the same procedures are employed to convert RNA to DNA for molecular cloning, RNA sequencing, Polymerase Chain Reaction (PCR), and genome analysis.

Howard Temin of the University of Wisconsin–Madison identified reverse transcriptases in Rous sarcoma virus, and David Baltimore of MIT isolated them from two RNA tumour viruses in 1970: murine leukaemia virus and Rous sarcoma virus. They shared the Nobel Prize in Physiology or Medicine with Renato Dulbecco in 1975 for their contributions. Among the well-studied reverse transcriptases are:

- The HIV-1 reverse transcriptase from human immunodeficiency virus type 1(PDB: 1HMV) is made up of two subunits with molecular weights of 66 and 51 kDas, respectively.
- M-MLV reverse transcriptase is a single 75 kDa monomer from the Moloney murine leukaemia virus.
- The avian myeloblastosis virus reverse transcriptase comprises two subunits: a 63 kDa subunit and a 95 kDa subunit.
- Telomerase is a reverse transcriptase that keeps eukaryotic chromosomal telomeres in good shape.

Process of reverse transcription or retro transcription

Reverse transcriptase converts an RNA template into double-stranded DNA. In virus species that lack DNA-dependent DNA polymerase activity, creation of double-stranded DNA could be accomplished by a host-encoded DNA polymerase mistaking viral DNA-RNA for a primer and synthesising double-stranded DNA via a mechanism similar to primer removal, in which the newly synthesised DNA displaces the original RNA template. Reverse transcription, also known as retrotranscription or retrotras, is a very error-prone process, and mutations can develop during this phase. Drug resistance may result from such mutations. Retroviruses are RNA reverse-transcribing viruses with a DNA intermediate, generally known as class VI ssRNA-RT viruses. Two molecules of positive-sense single-stranded RNA with a 5' cap and 3' polyadenylated tail make up their genomes. The human immunodeficiency virus and the human T-lymphotropic virus are two examples of retroviruses.

A "right hand" configuration is used by the reverse transcriptase, which is comparable to that of other viral nucleic acid polymerases. Retroviral reverse transcriptases feature an RNase H domain that is essential for their replication in addition to their transcription activity. It permits the other strand of DNA to be produced by destroying the RNA template. Some of the digestion's fragments also act as primers for the DNA polymerase, which creates the other (plus) strand. Because HIV copies its genetic material and generates new viruses via reverse transcriptase, certain medications have been developed to inhibit the process and so slow its spread. The nucleoside and nucleotide analogues zidovudine (Retrovir), lamivudine (Epivir) and tenofovir (Viread), as well as non-nucleoside inhibitors like nevirapine, are collectively known as reverse-transcriptase inhibitors.

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