WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review on RNA Interference

Pratik Harishchandra Machhi [a], Prof. Vandana Shirsath [b]

[a,b] Shree Mahavir Institute of Pharmacy, Nashik, India.

Abstract

RNA interference (RNAi) is a natural cellular mechanism that regulates gene expression through the degradation of messenger RNA (mRNA). This process involves small RNA molecules, including short interfering RNAs (siRNAs) and microRNAs (miRNAs), which target specific mRNA sequences and trigger their cleavage and subsequent degradation. RNAi has become an important tool in molecular biology research and is being investigated for therapeutic applications. In this abstract, we will provide an overview of the mechanisms and applications of RNA interference. We will first describe the molecular basis of RNAi and how it functions to regulate gene expression. We will then discuss the various applications of RNAi, including its use in gene silencing, target validation, and drug discovery. We will also review the challenges associated with the use of RNAi, including off-target effects and delivery issues. In conclusion, RNA interference is a powerful tool for investigating gene function and has numerous applications in basic research and therapeutic development. As our understanding of the molecular mechanisms of RNAi improves, we can expect to see even more exciting applications of this technology in the years to come.

KEY WORDS: RNA Interference, antiviral siRNA, antiviral shRNA, gene.

Introduction

RNA interference (RNAi) is a naturally occurring process in cells that regulates gene expression by silencing or "turning off" specific genes. RNAi is triggered by small, double-stranded RNA molecules called small interfering RNAs (siRNAs) or microRNAs (miRNAs) that bind to messenger RNAs (mRNAs), which carry the genetic information from DNA to the protein-making machinery of the cell. Once bound, the siRNAs or miRNAs target the mRNA for destruction or prevent it from being translated into protein, thus reducing the amount of protein that is produced.

RNA interference has important roles in many biological processes, including development, differentiation, and defence against viruses and other pathogens. It has also been used extensively as a tool in genetic research and in the development of new therapies for a variety of diseases, including cancer, viral infections, and genetic disorders. The discovery of RNAi has revolutionized the field of molecular biology and has opened up new avenues for understanding gene regulation and developing novel therapies.

Theory

RNA interference (RNAi) is a biological process in which small RNA molecules, typically 20-30 nucleotides in length, silence gene expression by targeting complementary messenger RNA (mRNA) molecules for degradation or translational repression. RNAi is a highly conserved mechanism found in many eukaryotic organisms, including plants, animals, and fungi.

The process of RNAi begins with the production of short double-stranded RNA molecules, known as small interfering RNAs (siRNAs) or microRNAs (miRNAs), by an enzyme called Dicer. These siRNAs or miRNAs are then incorporated into a protein complex known as the RNA-induced silencing complex (RISC), which binds to complementary mRNA molecules and either cleaves them or inhibits their translation.

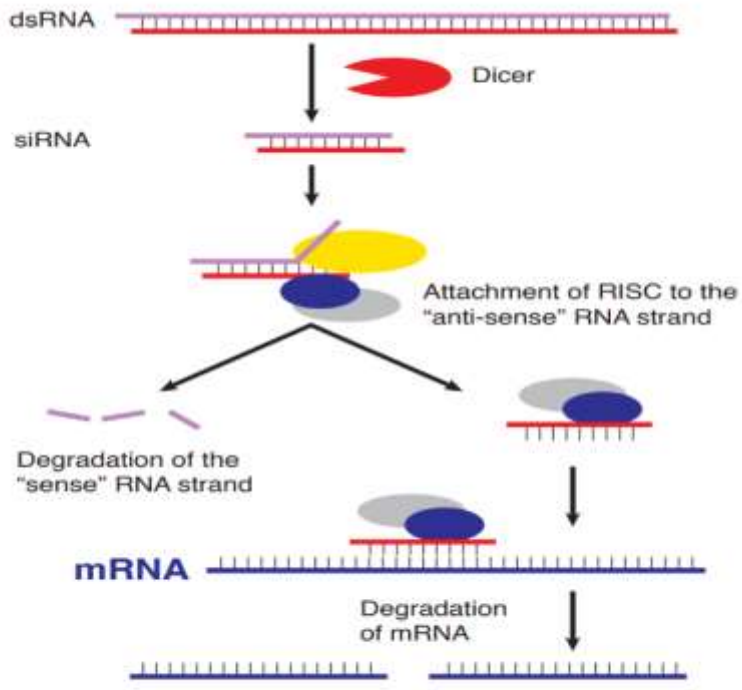

Figure I-6-11. RNAi Pathway

RNAi has numerous functions in the cell, including regulation of gene expression, defence against viral infection, and maintenance of genome stability. It has also emerged as a powerful tool for gene silencing in research and therapeutic applications.

The discovery of RNAi has revolutionized our understanding of gene regulation and has opened up new avenues for the development of novel therapeutics. RNAi-based therapies hold great promise for the treatment of a wide range of diseases, including cancer, viral infections, and genetic disorders. Despite its potential, RNAi still faces several challenges, including delivery of RNAi molecules to specific tissues and cells, off-target effects, and the potential for immune activation. However, ongoing research and development efforts are focused on addressing these challenges and unlocking the full potential of RNAi as a therapeutic tool.

Applications

RNA interference (RNAi) is a powerful tool that has been widely used in research and has also shown great potential in therapeutic applications. RNAi is a natural cellular process that regulates gene expression by degrading specific mRNA molecules, thereby preventing the translation of certain proteins. This mechanism can be harnessed to selectively silence target genes, providing a powerful tool for studying gene function and potential therapeutic intervention.

Here are some applications of RNA interference:

- **Gene silencing**: RNAi can be used to selectively silence specific genes of interest. This technique has been widely used in research to study the function of genes, including disease-causing genes. By silencing genes involved in disease processes, RNAi has the potential to provide new treatments for a range of diseases.
- **Cancer therapy**: RNAi has been explored as a potential cancer therapy by targeting oncogenes or genes involved in tumour suppression. By selectively silencing genes involved in cancer progression, RNAi has the potential to provide a targeted and effective treatment option.
- **Viral infections**: RNAi has been shown to be effective in inhibiting viral replication and could be used to develop new antiviral therapies. By targeting specific viral genes, RNAi could provide a more effective treatment option than current antiviral drugs.
- **Crop improvement**: RNAi has been used in agriculture to enhance the nutritional value of crops or to make them more resistant to pests and diseases. By selectively silencing genes involved in these processes, RNAi has the potential to improve crop yields and reduce the need for pesticides.

- **Functional genomics**: RNAi can be used to study the function of genes on a large scale. By selectively silencing individual genes and observing the resulting changes in cellular function, researchers can gain a better understanding of the roles that specific genes play in various biological processes.
- Overall, RNA interference is a powerful tool with a wide range of potential applications in both research and therapeutic settings.

Reference

1. Aalto, A. P., Sarin, L. P., van Dijk, A. A., Saarma, M., Poranen, M. M., Arumäe U., et al. (2007). Large-scale production of dsRNA and siRNA pools for RNA interference utilizing bacteriophage phi6 RNA-dependent RNA polymerase. RNA 13, 422–429. doi: 10.1261/rna.348307.
2. Alkhatib, G. (2009). The biology of CCR5 and CXCR4. Curr. Opin. HIV AIDS 4, 96–103. doi: 10.1097/COH.0b013e328324bbec.
3. Alvarez, R., Elbashir, S., Borland, T., Toudjarska, I., Hadwiger, P., John, M., et al. (2009). RNA interference-mediated silencing of the respiratory syncytial virus nucleocapsid defines a potent antiviral strategy. Antimicrob. Agents Chemother. 53, 3952–3962. doi: 10.1128/aac.00014-09.
4. Anderson, E., Boese, Q., Khvorova, A., and Karpilow, J. (2008). Identifying siRNAinduced off-targets by microarray analysis. Methods Mol. Biol. 442, 45–63. doi: 10.1007/978-1-59745-191-8_4.
5. Beaucage, S. L. (2008). Solid-phase synthesis of siRNA oligonucleotides. Curr. Opin. Drug Discov. Devel. 11, 203–216.
6. Bitko, V., and Barik, S. (2001). Phenotypic silencing of cytoplasmic genes using sequence-specific double-stranded short interfering RNA and its application in the reverse genetics of wild type negative-strand RNA viruses. BMC Microbiol. 1:34.
7. Bitko, V., Musiyenko, A., Shulyayeva, O., and Barik, S. (2005). Inhibition of respiratory viruses by nasally administered siRNA. Nat. Med. 11, 50–55. doi: 10.1038/nm1164.
8. Bobbin, M. L., Burnett, J. C., and Rossi, J. J. (2015). RNA interference approaches for treatment of HIV-1 infection. Genome Med. 7:50. doi: 10.1186/s13073-015-0174-y
9. Chiu, Y. L., and Rana, T. M. (2003). siRNA function in RNAi: a chemical modification analysis. RNA 9, 1034–1048. doi: 10.1261/rna.5103703.