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Global Journal of Life Sciences and Biological Research

ISSN: 2456-3102

Perspective

Catalytic RNA: RNA's Role as Catalysts in Biological Reactions

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DESCRIPTION

RNA, traditionally known for its role in gene expression and protein synthesis, has emerged as a remarkable molecule with catalytic properties. RNA catalysis, also known as ribozymes, challenges the dogma that catalysis is exclusive to protein enzymes. This study describes about RNA catalysis, highlighting its unique features, mechanisms, and potential applications.

Fundamentals

In the production of proteins, there are three primary kinds of RNA. They are Ribosomal RNA (rRNA), Messenger RNA (mRNA), and Transfer RNA (tRNA).

The genetic code needed to generate proteins is found in mRNA, which is produced from DNA. Prokaryotic mRNA doesn't need to be translated; it can start synthesizing proteins right away. A newly generated RNA transcript in eukaryotes is referred to as a pre-mRNA and needs to go through maturation to become an mRNA. Introns and exons, which are referred to as coding and non-coding sections, respectively, are found in pre-mRNA. The exons are linked together and the introns are spliced during the processing of pre-mRNA. The 5' end of the RNA transcript receives a 5' cap called 7-methylguanosine, while the 3' end is polyadenylated. The procedure known as "polyadenylation" involves

RNA as a catalyst

RNA catalysis refers to the ability of RNA molecules to accelerate chemical reactions by serving as enzymatic catalysts. This discovery shattered the notion that catalysis was solely the domain of proteins. Ribozymes are RNA molecules with specific three-dimensional structures that enable them to bind to and modify target molecules. Their catalytic activities are driven by a combination of base pairing, tertiary interactions, and metal ion coordination.

RNA catalysis has transformed the understanding of the molecular world by highlighting the catalytic potential of RNA molecules. As research in this field progresses, it can be expected unlock even more diverse and powerful applications, ultimately leading to significant advancements in medicine, biotechnology, and chemical synthesis.

Mechanisms of RNA catalysis

There are different mechanisms by which RNA molecules can catalyze reactions. The most well-known mechanism is the cleavage of RNA itself, catalyzed by ribozymes called self-cleaving ribozymes. These ribozymes can cleave specific phosphodiester bonds within their own RNA sequence, resulting in two separate RNA fragments.

Another mechanism involves RNA acting as an enzyme in a manner similar to protein enzymes. For example, the hammerhead ribozyme exhibits a typical enzyme-substrate interaction, where the ribozyme binds to a specific RNA substrate and facilitates its cleavage. Similarly, the hairpin ribozyme can cleave RNA by bringing two distant regions into close proximity

Unique features of RNA catalysis

RNA catalysis possesses several unique features. First, RNA molecules can undergo structural changes upon binding to specific substrates, which allows for selective catalytic activity. Second, RNA catalysis can occur under a wide range of conditions, including high temperatures and extreme pH levels. This robustness makes ribozymes attractive for biotechnological applications.

Applications of RNA catalysis

The discovery and understanding of RNA catalysis have opened up exciting possibilities in various fields. One of the significant applications is in the development of therapeutic agents. Ribozymes can be engineered to target and cleave disease-causing RNA molecules, potentially offering new treatments for genetic disorders and viral infections.

Moreover, RNA catalysis has implications in the field of synthetic biology. Researchers are exploring ways to design and engineer novel ribozymes to carry out specific chemical

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Received: 22-May-2023, Manuscript No. GJLSBR-23-25348; Editor assigned: 24-May-2023, Pre QC No: GJLSBR-23-25348 (PQ); **Reviewed:** 07-Jun-2023, QC No: GJLSBR-23-25348; **Revised:** 15-Jun-2023, Manuscript No: GJLSBR-23-25348 (R); **Published:** 22-Jun-2023, DOI: 10.35248/2456-3102.23.9.036

Citation: Zin Li M (2023) Catalytic RNA: RNA's Role as Catalysts in Biological Reactions. Glob J Lif Sci Biol Res. 09:036.

reactions, which could revolutionize the production of pharmaceuticals, biofuels, and other valuable compounds.

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