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ISSN: 2167-7956
Journal of Biomolecular Research & Therapeutics

Commentary

A Brief Note on Protein Biosynthesis during Translation

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DESCRIPTION

Protein synthesis is the process by which cells make proteins. This is done in two phases: transcription and translation. Proteins perform many important functions as enzymes, structural proteins, or hormones. Protein synthesis is a very similar process in prokaryotes and eukaryotes, but with some differences. Protein synthesis can be broadly divided into two stages: transcription and translation. During transcription, the stretch of DNA that encodes a protein called a gene is converted into a template molecule called messenger RNA (mRNA).

PROTEIN BIOSYNTHESIS DURING TRANSLATION

During translation, mRNA is read by the ribosome. Ribosomes use the nucleotide sequence of mRNA to sequence amino acids. Ribosomes catalyze the formation of peptide bonds between encoded amino acids to form polypeptide chains. After translation, the polypeptide chain needs to be folded into a functional protein. For example, in order to function as an enzyme, the polypeptide chain must be properly folded to create a functional active site. In order to take a functional three-dimensional (3D) form, the polypeptide chain must first form a series of smaller underlying structures called secondary structures. The polypeptide chains of these secondary structures are then folded to create the overall 3D tertiary structure. After properly folded, the protein can mature further through various post-translational modifications. Post-translational modifications can change the ability of proteins to function where they are located inside the cell (such as the cytoplasm or nucleus) and the ability of proteins to interact with other proteins. Protein biosynthesis plays an important role in disease, as changes and errors in this process due to underlying DNA mutations or proteins are often the root cause of the disease. DNA mutations alter the subsequent mRNA sequence and then the mRNA-encoded amino acid sequence. Mutations can shorten the polypeptide chain by creating a stop sequence that causes translation to stop prematurely. Alternatively, mutations in the mRNA sequence change the specific amino acid encoded at that position in the polypeptide chain. This amino acid change can affect the ability of a protein to function or fold properly.

During translation, ribosomes synthesize polypeptide chains from mRNA template molecules. In eukaryotes, translation occurs in the cytoplasm of the cell, in prokaryotes, which lack a nucleus; the processes of both transcription and translation occur in the cytoplasm. Ribosomes are complex molecules made of a mixture of protein and ribosomal RNA, arranged into two subunits (a large and a small subunit), which surround the mRNA molecule. The ribosome binds the mRNA molecule in a 5` 3' direction and uses it as a template to determine the order of amino acids in the polypeptide chain. In order to translate the mRNA molecule, the ribosome uses small molecules, known as transfer RNAs (tRNA), to deliver the correct amino acids to the ribosome. Each tRNA is composed of 7080 nucleotides. There are 60 different types of tRNA, each tRNA binds to a specific sequence of three nucleotides known as a codon. Within the mRNA molecule and delivers a specific amino acid. The ribosome initially attaches to the mRNA at the start codon (AUG) and begins to translate the molecule.

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Received: 04-Feb-2022, Manuscript No. BOM-22-15928; **Editor assigned:** 07-Feb-2022, Pre QC No. BOM-22-15928(PQ); **Reviewed:** 18-Feb-2022, QC No. BOM-22-15928; **Revised:** 22-Feb-2022, Manuscript No. BOM-22-15928(R); **Published:** 25-Feb-2022, DOI: 10.35248/2167-7956.22.11.198.

Citation: Joel V (2022) A Brief Note on Protein Biosynthesis during Translation. J Biomol Res Ther. 11:198.