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Short Communication

The Role of Protein Modification in Disease Development and Progression

Chien Shan*

Department of Pharmacology, Yangzhou University, Yangzhou, China

DESCRIPTION

Various pathways of protein biogenesis involve the ribosome as an active participant. Proteins need to be functional for cellular processes. This requires new proteins to be shaped, modified, and sent to their correct locations in the cell. Many of these steps happen early during translation, when the proteins are being synthesized. Protein modification is a process that alters the structure or function of proteins by adding or removing chemical groups or peptides. Protein modification can occur during or after protein synthesis, and can affect various aspects of protein activity, stability, localization, and interactions. Protein modification is one of the major mechanisms that regulate cellular processes and responses to stimuli [1].

Protein modification plays a crucial role in disease development and progression, as it can modulate the expression, activity, or stability of disease-related proteins. Abnormal or dysregulated protein modifications can contribute to the pathogenesis of various diseases, such as cancer, neurodegeneration, inflammation, and infection. Protein modifications can also affect the response or resistance to drugs or therapies. Therefore, understanding the role of protein modification in disease biology can provide valuable insights into the molecular mechanisms, diagnosis, prognosis, and treatment of these diseases [2]. The formation and folding of proteins, known as protein biogenesis, often happens while the new protein chain is being made on the ribosome. The ribosome surface near the exit of the tunnel where the new protein chain comes out is acts as a center to attract different proteins that help with protein biogenesis. These include proteins that direct the new protein chain to its destination, such as SRP (Signal Recognition Particle) and SecA, proteins that help the new protein chain fold properly, such as TF, and proteins that modify the new protein chain. The new protein chain has molecular signals that start specific protein biogenesis pathways [3].

Protein modifications that are involved in disease development and progression

Phosphorylation is the process of addition or removal of phosphate groups to or from proteins by kinases or phosphatases. Phosphorylation is one of the most common and important protein modifications that regulate signal transduction and cellular communication. Phosphorylation can activate or deactivate proteins, alter their interactions with other proteins or molecules, or change their subcellular localization. Abnormal phosphorylation can lead to dysregulated signaling pathways and networks that are associated with various diseases, such as cancer, diabetes, Alzheimer's disease, and Parkinson's disease [4].

Ubiquitination is the process of attachment or removal of ubiquitin molecules to or from proteins by ubiquitin ligases or deubiquitinases. Ubiquitination is a key protein modification that regulates protein degradation, quality control, trafficking, signalling, and DNA (Deoxyribonucleic Acid) repair. Ubiquitination can mark proteins for degradation by the proteasome or lysosome, alter their interactions with other proteins or molecules, or modulate their activity or localization. Abnormal Ubiquitination can lead to accumulation of misfolded or damaged proteins, impaired proteostasis, altered signalling pathways and networks that are associated with various diseases, such as cancer, neurodegeneration, inflammation, and infection [5,6].

Glycosylation is the process of addition or removal of carbohydrate chains to or from proteins by glycosyltransferases or glycosidase. Glycosylation is a complex and diverse protein modification that affects protein folding, stability, trafficking, recognition, and interactions. Glycosylation can modify the structure and function of proteins on the cell surface or in secreted fluids, mediate cell-cell or cell-matrix adhesion, modulate immune responses and inflammation, and influence cell signalling and communication. Abnormal glycosylation can lead to altered protein expression levels, functions, or interactions that are associated with various diseases, such as cancer, diabetes, cardiovascular disease, and congenital disorders [7].

Nitrosylation is the process of addition or removal of nitric oxide groups to or from proteins by nitric oxide synthases or denitrosylases. Nitrosylation is a reversible and dynamic protein modification that regulates signal transduction and cellular

Correspondence to: Chien Shan, Department of Pharmacology, Yangzhou University, Yangzhou, China, E-mail: shanchien@edu.cn

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communication. Nitrosylation can modify the activity or interactions of proteins involved in various cellular processes such as apoptosis, autophagy, metabolism, transcription, and translation [8]. Abnormal nitrosylation can lead to oxidative stress, impaired mitochondrial function, inflammation, and neurodegeneration that are associated with various diseases, such as cancer, cardiovascular disease, Alzheimer's disease, and Parkinson's disease.

In conclusion, protein modification is a key process that influences the structure and function of proteins and modulates cellular processes and responses to stimuli. Protein modification plays a crucial role in disease development and progression, as it can modulate the expression, activity, or stability of disease-related proteins. Abnormal or dysregulated protein modifications can contribute to the pathogenesis of various diseases, such as cancer, neurodegeneration, inflammation, and infection. Protein modifications can also affect the response or resistance to drugs or therapies. Therefore, understanding the role of protein modification in disease biology can provide valuable insights into the molecular mechanisms, diagnosis, prognosis, and treatment of these diseases [9,10].

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