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White Paper

Key Aspects of Protein Structure

Protein structure in context with oxidative stress and oxidative response, and their importance in processes involving cell metabolism, detoxification, antioxidants and proteases.

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This white paper discusses protein structure as a fundamental construct of good health. There is a great deal of information on protein function and newly discovered proteins are among the hottest areas of medical research. This is not surprising given that the proper function of proteins is so critical to good health. For example, proteins are responsible for slowing down the aging of blood vessels by protecting against DNA damage or accelerating its repair.[i] With intense scrutiny of individual proteins, the critical role that protein structure plays in proper protein function tends to be overlooked. This paper briefly introduces the key aspects of protein structure. Further, it suggests that improving the environment or structure of proteins is a critical aspect of protein function.

Metabolism

Metabolism is the set of chemical reactions that occur in living organisms in order to maintain life.[ii] Enzymes, which are almost always proteins, are crucial for catalyzing all aspects of cell metabolism. They also allow organisms to drive desirable but thermodynamically unfavorable reactions by coupling them to favorable ones. The metabolism of an organism determines which substances it will find nutritious and utilize, and which it will find poisonous and respond to. In other words, proteins are involved in all processes of utilization and in all processes of elimination, both of which are essential to proper function.

Enzymes/Proteins

Proteins, which are biomolecules, are made of amino acids arranged in a linear chain and joined together by peptide bonds and hydrogen bonds.[iii] They are considered to be the most important of all molecules in living organisms because they carry out vital functions in and between every cell. Many proteins are the enzymes that catalyze the chemical reactions in metabolism. Other proteins have structural, transport or mechanical functions, for example, the proteins that form the hemoglobin, a transporter of oxygen in the blood. Proteins are also important in cell signaling, immune responses, cell adhesion, active transport across membranes and the cell cycle. Their functionality depends on their structure. Structural damage to proteins diminishes their ability to function and results in diminished metabolism. Structural damage is caused during oxidative stress and is called denaturation of protein.

Oxidative stress

The paradox in metabolism is that while the vast majority of complex life requires oxygen in their chemical reactions for its existence, oxygen is a highly reactive molecule that damages cellular components. Damage to proteins causes enzyme inhibition, denaturation, and protein degradation that can have serious health implications.[iv] For example, damage to DNA can cause mutations and possibly cancer, if not counteracted by enzymatic repair mechanisms. Oxidative stress is thought to be an important part of many human diseases. The enzymatic processes (metabolisms) of the responses, for example of antioxidants, are intensively studied. They are of particular interest as treatments for stroke and neurodegenerative diseases because they are thought to support health and prevent diseases such as cancer and coronary heart disease.

Responses

Response is the body's protein and enzyme-controlled processes that take care of detoxification, antioxidants, and protease. Because oxidative stress is a natural part of metabolism and life itself, response processes are essential to keep it in check. When oxidative stress exceeds the body's ability to respond to it, damage occurs. There are three important types of response, all of which rely on the proper function of proteins and enzymes.

1. Detoxification. All organisms are constantly exposed to compounds that they cannot use as foods and would be harmful if they accumulated in cells, as they have no metabolic function. These potentially damaging compounds, called xenobiotics, are detoxified by a set of metabolizing enzymes. The important process of detoxification clearly depends on the correct function of proteins and enzymes.
2. Antioxidants. Another group of damaging compounds are reactive oxygen species, also known as free radicals that occur during oxidative stress. These damaging oxidants are removed by antioxidant metabolites through enzymatic processes such as catalases and peroxidases. The process that involves antioxidants depends on the work of proteins and enzymes.[v]
3. Proteases. Another process controlled by enzymes that carry out such reactions is called proteases and is a major mechanism by which cells regulate the concentration of particular proteins and get rid of misfolded proteins. The main function of the protein proteasome is to degrade unneeded or damaged proteins. The process of proteases relies on the proper function of proteins and enzymes.[vi]

Protein structure support

All processes, including the response processes for repair and compensation, depend on the proper function of proteins and enzymes and each function depends on its structure.[vii] In order to perform their functions, it is necessary for proteins to first form the correct three-dimensional structure. The various types of structures are defined by their patterns of hydrogen bonds; therefore hydrogen bonds play an important role in determining the three-dimensional structures adopted by proteins. Hydrogen bonds ultimately affect protein function. The sum of all protein functions within a cell is called cellular activity.

Eng3's Technology

The growing knowledge about the effects of hydrogen bonds in both inorganic molecules (e.g. water) and organic molecules (e.g. proteins and DNA) is applied in Eng3's NanoVi technology.[viii] This patented technology is used in a drug-free biophysical process that influences hydrogen bonds making it easier to restructure damaged proteins. When proteins structure correctly, they regain proper function. This improves cellular activity in general. A most beneficial use of NanoVi technology is to address oxidative stress-damaged proteins. Better protein structure and function are important for improving metabolism and reducing oxidative stress-related medical problems. Boosting the repair of protein damage by influencing hydrogen bonds is a powerful way to avoid accumulation of oxidative stress damage and improve cellular activity. More information on this technology can be found at www.eng3corp.com or by contacting Eng3 Corporation at 877-571-9206.

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i http://www.admin.cam.ac.uk/news/dp/2008092603

ii For additional information on metabolism consider:
www.sciencetechnologyaction.com/lessons2.php?studyid=19&edition=1
www.bentham.org/ccb/samples/ccb%201-1/Szoke_CCB.pdf
www.en.wikipedia.org/wiki/Metabolism

iii A great deal of information is published on enzymes and proteins, the sources below provide additional related information:
www.sciencetechnologyaction.com/lessons2.php?studyid=3&edition=1
www.wikipedia.org/wiki/DSSP_(protein)

iv Oxidative stress: www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T56-4KJ06VG-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_version=1&_urlVersion=0&_userid=10&md5=5ff34574370c2199c9bb4205e48f2400
www.wikipedia.org/wiki/Oxidative_stress

v Antioxidants:
www.ncbi.nlm.nih.gov/pubmed/8660387?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DiscoveryPanel.Pubmed_Discovery_RC&linkpos=5&log$=relatedreviews&logdbfrom=pubmed
www.ncbi.nlm.nih.gov/pubmed/9437876?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DiscoveryPanel.Pubmed_Discovery_RC&linkpos=2&log$=relatedreviews&logdbfrom=pubmed
www.en.wikipedia.org/wiki/Antioxidant

vi Protease:
www.bb.iastate.edu/~jat/glutchp.html
www.jeb.biologists.org/cgi/reprint/206/18/3119.pdf
www.nature.com/onc/journal/v18/n45/full/1203175a.html
www.wikipedia.org/wiki/Proteasome

vii Protein structure:
www.friedli.com/herbs/phytochem/proteins.html#protein_structure
www.wikipedia.org/wiki/DSSP_(protein)

viii Hydrogen bond:
www.mansfield.ohio-state.edu/~sabedon/black02.htm
www.americanscientist.org/issues/feature/biomolecules-and-nanotechnology/1
www.wikipedia.org/wiki/Hydrogen_bond