Indexed, Abstracted and Cited: Index Copernicus International (Poland), ISRA Journal Impact Factor, International Impact Factor Services (IIFS), Directory of Research Journals Indexing (DRJI), International Institute of Organized Research and Scientific Indexing Services, Cosmos Science Foundation (South-East Asia), International Innovative Journal Impact Factor, Einstein Institute for Scientific Information {EISI}, Directory of Open Access Scholarly Resources, Science Indexing Library (UAE), Swedish Scientific Publication (Sweden), citefactor.org journals indexing, Directory Indexing of International

World Journal of Biology and Medical Sciences

Published by Society for Advancement of Science®

ISSN 2349-0063 (Online/Electronic)

Volume 7, Issue-1&2, 54-58, January - June, 2020

Journal Impact Factor: 4.197

WJBMS 07/02/09/2020

A Double Blind Peer Reviewed Journal / Refereed Journal

www.sasjournals.com

wjbmedsc@gmail.com/wjbms.lko@gmail.com

REVIEW ARTICLE

Received: 30/04/2020 Revised: 02/06/2020 Accepted: 03/06/2020

Extra Dimensions in the Central Dogma of Molecular Biology-Lipids as Final Destination of Information Flow in Biological Systems

Haghamad Allzain

Department of Biochemistry, Faculty of Medicine, Shendi University, Sudan

ABSTRACT

The great scientist Francis Harry Compton Crick coined the term "Central Dogma of biology" and first stated in 1958, and then reiterated and basically reaffirmed it in his seminal paper "Central Dogma of molecular biology" , which was published in Nature in August 1970. It was an idea that "information" flows one-way from nucleic acids (DNA and RNA) to proteins and never in the reverse direction. The question that should be answered is that; does the DNA information flow in biological systems end at the level of proteins as the final and ultimate product of the genetic material, the DNA. What are the role of other biomolecules and environmental factors in the transfer of information in existing biological systems? This simple and humble discussion is an attempt to tackle this argument that is the extension of biological information flow to other cellular macromolecules such as carbohydrates and lipids, which could be the final destination of flow of biological information such that information in the sequence of the nuclear DNA finally appears in the lipids structure of cell membrane. The purpose of this article is to draw attention to the fact that the biological information carried in the DNA does need flow to other cellular biomolecules such as carbohydrates and lipids. This is a key conceptual point addressed in the main text of this article.

Key words: Central Dogma, DNA, RNA, Protein, Carbohydrates and Lipids.

Abbreviations: DNA (Deoxy, Nucleic Acid), RNA (Ribonucleic acid)

INTRODUCTION

Francis Crick stated that "The Central Dogma of molecular biology deals with the detailed residue by residue transfer of sequential information. It states that such information cannot be transferred back from protein to either protein or nucleic acid" (Crick, F August 1970).

Information means here the precise determination of sequence, either of bases in the nucleic acid or of amino acid residues in the protein.

The Dogma is a framework for understanding the transfer of sequence information between information carrying biopolymers, in the most common or general case, in living organisms. There are three major classes of such biopolymers: DNA and RNA and protein.

However, it appears to be a fundamental 'biological law' that is deeply rooted in the molecular set up of the information flow in all cells. However, the Central Dogma is not about a specific molecular mechanism but rather about information flow (Koonin V Eugene. 2012).

Crick explained his choice of the term Central Dogma other than hypothesis to suggest that this new assumption was more central and more powerful.

Since the sixties of the last century, the function of DNA has dominated recent biology and the Central Dogma has never been overthrown or seriously challenged.

The Impact of Epigenetic Mechanisms

The term "epigenetics" means "above genetics" and refers to the fact that these regulatory mechanisms do not change the underlying regulated DNA sequence, but rather simply the expression patterns, or function, of this DNA. Thus it represents the inheritable changes to the chemical control system governing the gene expression with no ensuing changes to the underlying DNA sequence. Environment-mediated modification of the natural epigenetic interactions can perturb the cellular homeostasis and drive cells to a diseased state by switching therapeutically essential genes on and off (Vaijayanthi, 2018).

The language of DNA operates with four (4) letters for its words, Adenine, Guanine, Cytosine, and Thymine, with several words forming a sentence that eventually is translated into a protein. The proteins are built with twenty (20) words, the amino acids that are assembled into a meaningful three (3) dimensional structures. Going downstream the carbohydrates are built with greater type of monomers than proteins, the different types of monosaccharide, that formed the variety complex polysaccharides. Where there are about three hundred and forty (340) of the most common molecular species of lipids, seven hundred and twenty (720) common and several thousands (1,000s) altogether if the rarer and sometimes trace amounts are counted, with high degree of structural sophistication provides for the multi dimensional requirements for the physical and electrochemical environment for protein function (Crawford et al 2014).

The life forms of the first two and half (2.5) billion after the origin of life were anaerobic, However, the Cambrian explosion was associated with the appearance of intracellular detail, which is provided by cell membranes which mean lipids. This change occurred when oxidative metabolism becomes thermodynamically possible after rising of oxygen tension. It is more efficient than anaerobic metabolism in such way that gives a total of thirty (32) ATP per mole of glucose instead of only two (2) under anaerobic conditions. When that happened about six hundred (600) million years ago, multi-cellular, air breathing systems evolved and all the thirty two (32) phyla of life kingdom has existed unto date (Crawford and Broadhurst 2012).

It is likely that the proteins dictated the lipids first as the proteins had two and half (2.5) billion years of evolution ahead of the sophisticated lipids (Crawford MA, et al.2014). Also proteins as catalysts dictate the metabolism of carbohydrates which are more diversified than proteins. Carbohydrates can be considered as intermediate molecules exist between proteins and lipids. Oxidative metabolism of carbohydrates provides the precursors and energy necessary for the synthesis of sophisticated lipids, with oxygen is used for desaturation of long chain fatty acids to form the polyunsaturated long chain fatty acids with up to six double bonds.

Darwin in the Origin of Species (1868) stated there were two forces in evolution, natural selection and the conditions of existence. Of the two, he said, the latter was the most powerful. He spent much of the later part of his life searching for what he called “Pangenes” that were responsible for translated environmental influences. However, Darwin’s “Pangenes” are now evident in the responding of plasma membrane receptors to nutrients influencing gene expression and vice versa (Crawford 2008).

The above argument can be perceived in sickle cell disease, a multisystem disorders, which is a group of autosomal recessive genetic blood disorders characterized by single nucleotide substitution, GAG —> GTG in codon six (6) of the β-globin gene on chromosome eleven (11), which causes single amino acid substitution of glutamic acid replaced by valine, at the sixth (6) position of the β-globin chain, approximately 300,000 infants are born annually with homozygous SCD, and that number could rise to 400 000 by 2050 (Daak 2018). This genetic defect finally leads to perturbation of lipids composition of cell membrane. Blood cells and plasma of patients with Sickle cell disease show decreased levels of docosahexaenoic (DHA) and eicosapentaenoic (EPA), with increased levels of the pro-inflammatory ώ-6 fatty acid arachidonic acid. Attempt to correct this abnormality by supplementation of DHA and EPA is promising (Daak, 2012, Daak, 2013, Daak and Ghebremeskel 2013).

The environmental cues as well as nutrition could have a direct effect on the flow of genetic information. It is the bigger picture of transfer of biological information from DNA in the nucleus to other cellular macromolecules, up to the level of lipids of the cell membrane. The evidence from evolution strongly supports these arguments, as lipids still modifying our species today (Crawford, 2013, Crawford, 2014).

The current perception preoccupied with the proteins as ultimate product of the DNA information, has led to relative underestimation of the biological importance and roles of other cellular macromolecules such as lipids, which in turn reflected in food policy of the last half of the past and current century, with the focused on protein and growth factors, and little attention and sometimes hostile attitude towards carbohydrates and lipids. That food policy needs to be redefined as the gap between understandings of nutritional sciences, epigenetics is too wide to comfort (Crawford MA. 2012).

CONCLUSION

From the above argument, it could be concluded that the biological information in DNA flow to RNA, to proteins, to carbohydrates, and finally to lipids in cell membranes. However the transfer of information to the last two macromolecules is not as symmetrical and faithful as between the first three ones.

Author's contributions

Haghamad Allzain conceived the idea and wrote the manuscript.

Competing interests

The author declares that he has no competing interests.

REFERENCES

Adam S. Wilkins (2012). Review of *Evolution: A View from the 21st Century* by James A. Shapiro. Upper Saddle River (NJ): FT Press Science, 2011. 253. *Genome Biology and Evolution*, Volume 4, Issue 4, 1 January 2012, Pages 423–426.

Crawford, M.A. and Broadhurst, C.L. (2012). The role of docosahexaenoic and the marine food web as determinants of evolution and hominid brain development: The challenge for human sustainability. *Nutrition and Health*; 21(1) 17-39

Crawford, M.A., Broadhurst, C.L., Cunnane, S. et al. (2014). Nutritional armour in evolution: docosahexaenoic as a determinant of neural evolution and hominid brain development. *Military Medicine;* 179(11S):61-75. PMID: 25373088

Crawford, M.A., Broadhurst, C.L. Guest, M.A., et al (2013). A quantum theory for the irreplaceable role of docosahexaenoic acid in neural cell signaling throughout evolution. *Prostaglandins Leukotrienes and Essential Fatty Acids*; 88 (1): 5-13; DOI: 10.1016/j.plefa.2012.08.005

Crawford, M.A. et al. (2008). The Role of Docosahexaenoic and Arachidonic Acids as Determinants of Evolution and Hominid Brain Development. In: K. Tsukamoto, T. Kawamura, T. Takeuchi, T. D. Beard, Jr. and M. J. Kaiser, eds. Fisheries for Global Welfare and Environment, *5th World Fisheries Congress*, pp. 57–76

Crawford, M.A. (2012). The crisis in nutrition and poverty. *Nutrition and Health*; 2(4)205-208.

Crawford, M.A. (1992). The role of dietary fatty acids in biology: their place in the evolution of the human brain ; *Nutrition Reviews*, Vol. 50, No. 4, (11) 3-11).

Crawford, M.A., Broadhurst, C.L., Galli, C. et al (2008). The role of docosahexaenoic and arachidonic acids as determinants of evolution and hominid brain development. *Fisheries for Global Welfare and Environment, 5th World Fisheries Congress*; pp. 57–76.

Crick, F. (1970). Central dogma of molecular biology. Nature. 227 (5258): 561–563.

Daak, A.A. et al (2018). Double-blind, randomized, multicenter phase 2 study of SC411 in children with sickle cell disease (SCOT trial) - *blood advances* -14 August 2018 - volume 2, number 15.

Daak, A.A., Kebreab Ghebremeskel, Zahir Hassan, Bakhita Attallah, Haj H Azan, Mustafa I Elbashir and Michael Crawford (2013). Effect of omega-3 (n23) fatty acid supplementation in patients with sickle cell anemia: randomized, double-blind, placebo-controlled trial. *Am J Clin Nutr*; 97(1):37-44.

Daak, A.A. and Ghebremeskel, K. (2013). Omega-3 fatty acids and sickle cell disease: Intriguing association and promising therapeutic effect. *Lipid Technology*. 25 (12): 275-277.

Daak, A.A. (2012). Clinical and biochemical effects of omega-3 fatty acid supplementation on patients with homozygous Sickle cell disease. Metropolitan University, Institute of Brain Chemistry and Human Nutrition London N7 8DB, UK. *PhD thesis*. P: 185.

Eugene V. Koonin (2012). Does the central dogma still stand ?. *Biology Direct 7*: 27.

Laurence A. Moran (2012). Review of *Evolution: A View from the 21st Century.* by James. A. Shapiro. Upper Saddle River (NJ): FT Press Science, 2011. 253 pages. National Center for Science Education. *RNCSE* 32.3, 9.1. ISSN 2159-9270

Vaijayanthi, T., Pandian, G.N. and Sugiyama, H. (2018). Chemical Control System of Epigenetics. *Chem Rec*.; 18(12):1833-1853.

Corresponding author: Dr. Haghamad Allzain, Assistant Professor in the Department of Biochemistry- Faculty of Medicine, Shendi University, Sudan.
Email: hajamadbulla@yahoo.com.
Mobile: +249924589361