Nahal Farvardin

Origin of life has always been a controversial subject. Many attempts have been made by scientists to find some sort logic to explain the evolution of organic molecules and cells. One approach to unlock the mystery of the evolution is to understand which biological molecule came first; RNA, DNA, or the proteins, and the other approach is to understand which organism or cell type is the precursor to the other cell types. Historically, three theories, the "Protein Theory," the "RNA Theory" and the "PNA Theory" have gained popularity for over the last century. The Protein Theory claimed that the first living thing was a protein, which was soon rejected since proteins cannot replicate self and as a result natural selection cannot occur. Hence, the RNA Theory and PNA Theory took an edge over the Protein Theory. Moreover, understanding the process of cell evolution is also critical to understanding the origin of life.

As a less complex and a less selective molecule compared to a protein, initially RNA seemed to make a good candidate to have existed before either the DNA or the protein molecules. Existence of single strand RNA viruses capable of coding for proteins and DNA, incorporation of rRNA in the structure of the ribosomes, and dependency of protein synthesis to mRNA could be strong supporters of such school of thought that RNA existed before the DNA and the proteins. Moreover, RNA seems to act as a bridge between DNA and proteins by relating to the DNA via transcription, and to the proteins via translation. In addition, random assembly of simpler RNA molecules could have lead to the production of the very first simple RNA molecules, which could have lead to protein synthesis by bringing amino acid molecules in close vicinity to form peptide bonds, not to forget that RNA could be a template for DNA production.

Although the RNA theory is very convincing, the "PNA Theory" is more appealing compared to both the "RNA Theory" and the "Protein Theory." As a candidate probiotic molecule, PNA acts as a hybrid entity that shares the properties of both the RNA and the protein molecules, most notably its capability to form hydrogen bond-stabilized double helix structure with a peptide-like backbone composed of ethylenediamine monoacetic acid units. In addition, strands similar to a DNA molecule, PNA is capable of binding complementary nucleic acids. Hence, although PNA is not proven to occur naturally, it makes a great candidate for the probiotic molecule.

To further investigate the origin of life and the evolution of biomolecules, one must also consider certain characteristics that lead to differentiation of prokaryotes from eukaryotes and the evolution of prokaryotes to eukaryotes. Among archaea, bacteria, and eukaryotes, several characteristics that archaea shares with the eukaryotes makes it the best possible precursor for the eukaryotic cells, including existence of histone protein, and certain enzymes involved in transcription and translation in archaea that are also present in the eukaryotes. Moreover, eukaryotes are believed to be the product of fusion of archaea and bacteria.

Understanding the function of viruses inside the living cells is also important when it comes to the process of evolution. As central dogma indicates, living cells function in an organized manner to transcribe mRNA from DNA and then translate mRNA to protein.

However, viruses have several ways of interacting with this process that does not necessarily follow the usual direction of the central dogma. Different viruses enter the central dogma in different manners and at different stages. For instance, retroviruses produce DNA from RNA via reverse transcriptase. Also, some DNA viruses to exert their effect first produce viral RNA, which in turn acts as a template for viral DNA production within the cell. Such capability of viruses to interact with the protein synthesis machinery of living cells is indicative of the importance of RNA and its potential primitive form, PNA, as the most probable probiotic molecules.

Consequently, based on all the evidence present and its primitive and flexible characteristics, PNA is the best candidate to be the probiologic molecule despite of not being proven to occur naturally. In addition, the way viruses interact with central dogma, and the process of evolution of eukaryotes from archaea suggests the need for a molecule with characteristics similar to PNA, a hybrid molecule with properties similar to both protein and RNA.