*Evolution of Protein Molecules: Pathways of the 20 Standard Amino Acids of the Genetic Code

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Introduction: Understanding of the origin of then genetic code is still confusing to the science community. The events surrounding the emergence of the genetic code are full of mystery. From a pool of available molecules, life ended up using four nucleotides and twenty amino acids to encode and build its proteins. By the time of the Last Universal Common Ancestor (LUCA), the process of protein translation was largely fixed in the form of the standard genetic code. From this biochemical foundation, life has evolved such diversity that 21st century astrobiology is challenged to "*elucidate the biochemical capabilities that define the limits for cellular life*".

In this present research effort, we set about to investigate whether a contemporary view of metabolic diversity supports the assertion that pathways of amino acid biosynthesis contain molecular fossils that connect "early" and "late" amino acids. We also investigate whether metabolic pathways found in living organisms are indeed an accurate guide to ancient evolutionary events. The project goal is to provide additional insight into the emergence of a standard alphabet of 20 genetically encoded amino acids.

Our preliminary findings support earlier reports that the 20 amino acids of the standard genetic code comprise of two different groups: "early" amino acids that were likely available at the origin for life through prebiotic syntheses, and "late" amino acids that are best understood as inventions of biology itself. However, the results question the underlying ideas of some of the theories surrounding the evolution or emergence of the 20 encoded amino acids of the standard genetic code, especially the "precursor-product" assertion of the "Co-Evolution theory". We conclude that the whole idea about the origin of amino acids of the standard genetic code is far from being resolved and that there is need for a critical evaluation of the theories surrounding the emergence of the 20 standard amino acids.

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