

**Nucleic Acids (DNA and RNA) are not boring long polymers
composed of only four types of nucleotides: evolutionary implications**

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Chemically altered nucleosides derived from canonical deoxyribo- or ribo-nucleoside derivatives of adenosine, guanosine, cytidine, thymidine or uridine are found in all types of nucleic acids, DNA and RNAs. They are particularly abundant in noncoding RNAs, such as transfer RNAs and ribosomal RNAs of metazoan. By increasing the structural diversity of nucleic acids, naturally occurring modified nucleosides play important roles in gene expression and in regulating (tuning) many aspects of nucleic acids functions. They also contribute to thermal stability and protection of nucleic acids against nuclease digestion as well as of genetic materials against virus aggression.

Special attention will be given to modified nucleotides that are present in the anticodon loop of transfer RNA, especially at first wobble position 34 and purine 3'-adjacent to anticodon (position 37). Some of these modified nucleotides (and corresponding tRNA modification enzymes) are very ancient, while other emerged later during cellular evolution. In frame mRNA translation on the ribosome, progressive introduction to up to 22 amino acids and convergence of the genetic code towards an almost universal genetic language allowing cross-talking between the different species of the three domains of life were certainly among important evolutionary constraints.

Among other characteristic conserved modified nucleotides in tRNAs are those present in the so-called T-arm and D-arm (positions 8-26 and 49-65 respectively). They are located within the core of the characteristic L-shaped 3-D structure of fully mature and functional tRNAs. Systematic presence or exclusion of a given modified nucleotide in the tRNA molecules belonging to thermophilic, mesophilic and psychrophilic organisms allows to stress about their importance in regulating the stability and flexibility of this region of the tRNA molecules. On evolutionary point of view, they appear more like adaptation devices rather than primitive features, thus supporting the hypothesis that present-day hyperthermophiles are not direct descendent of hypothetical primitive cells but rather result from secondary adaptation during evolution from less hyperthermophilic organisms.

To obtain up-to-date information about the discoveries, the biochemical and biophysical properties of the enzymes identified so far that accomplish these nucleic acids 'decorations', the reader have to consult a book recently published in 2009 by LANDES BioScience (Austin, Texas, USA): **DNA and RNA Modification Enzymes: Structure, Mechanism, Function and Evolution** (H. Grosjean, editor). ISBN 978-1-58706-329-9; or consult each of the 41 chapters individually at the following Web site address:

<http://www.landesbioscience.com/curiechapter/4181/>

see also: <http://www.springerlink.com/content/?k=RNA+Modification+Editing>