Keio University

Thesis Abstract

No.

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Title of Thesis:

Expansion of the Genetic Code Deciphered by Molecular Biological Analysis of Genus-Specific Transfer RNA

Summary of Thesis:

The genetic code is a set of essential and fundamental rules for living cells, and is highly conserved among all organisms. During translation according to the genetic code, transfer RNA (tRNA) acts as an adaptor molecule by physically linking the nucleotide sequence of genetic information and the amino acid sequence of a protein. In some cases, tRNA changes have direct and specific effects on the decoding process, and hence a full investigation of the evolution and function of the tRNA molecule is necessary for a comprehensive understanding of the genetic code. In this study, we focused on the evolutionary divergence of eukaryotic tRNAs, and examined their structural and chemical properties based on bioinformatics and molecular biology approaches. We identified a novel type of tRNA (designated "nev-tRNA") with unusual structural characteristics that specifically diverged in the nematode lineage. Surprisingly, these tRNAs can translate nucleotides *in vitro* in a manner that transgresses the genetic code. We also confirmed that nev-tRNAs are expressed, matured, and exported from the nucleus *in vivo*. However, it is highly likely that nev-tRNAs are not used in protein biosynthesis, at least under normal growth conditions, and are therefore assumed to be involved in specific processes, such as responses to environmental changes. These findings provide the first example of unexpected tRNAs that can potentially alter the general translation rule for higher eukaryotes, and allow new insights into the genetic code and a new perspective on modern tRNA biology.

Keywords: Genetic code; Transfer RNA; Protein; Translation; Nematode; Molecular evolution