2012.5.29

BIOLOGICAL SYSTEMS IN MICROORGANISMS

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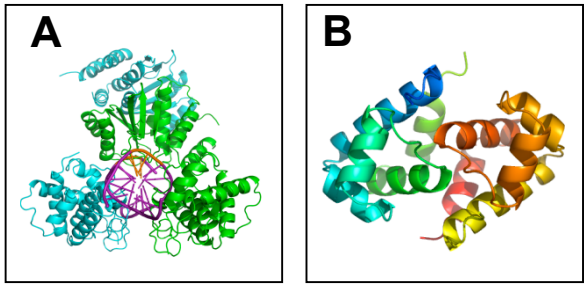
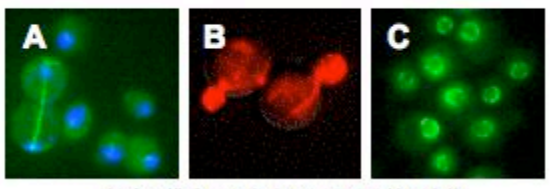
Microorganisms are always challenged with a variety of stresses in the natural environment. However, they undertake all exquisite strategies to survive under such stressful conditions. For instance, bacteria have the restriction endonucleases to specifically cleave the phage DNA but not their own genomic DNA, which is one of the self-defense systems of bacteria against phage infection. On the other hand, yeast has a very complex system like human cells to respond to the endogenous stressors such as reactive oxygen species. We aim to clarify the entire mechanisms of adaptation to environmental changes of microorganisms by analyzing the molecular structure and function of proteins, gene expression, and signal transduction systems involved in the self-defense system.

Restriction-Modification System of Bacteria

Bacteria have a restriction-modification system to distinguish their own genomic DNA from the foreign DNA. The restriction endonuclease is an enzyme that recognizes and cuts the specific base sequence of the foreign DNA, which is also an essential tool for the gene engineering. We are taking many approaches to study the mechanism of the base sequence recognition as the specific DNA-binding protein, as well as the mechanism of molecular evolution that results in developing various enzymes. Moreover, we are also analyzing the regulation of the expression of genes involved in the restriction-modification system, because the restriction endonuclease acts as a kind of "poison" in bacterial cells.



Structures of proteins for the restriction-modification system
A, restriction endonuclease-DNA complex
B, transcriptional regulator



Staining of cellular components
A, microtubule; B, actin; C, nuclear envelope.

Cellular Mechanism of Adaptation to Environment: Yeast as a Model System

The cellular structure of yeast is similar to that of higher eukaryotes like the human cell. Additionally, various biological events that occur in the cell also resemble each other. In fact, thus far, the detailed mechanisms of many important biological events have been clarified using yeast as a model organism. We are trying to determine what kind of gene is expressed when yeast cells are exposed to environmental changes, how such genes are regulated, and also how mRNAs and gene products derived from such genes are trafficked and functioning in the cell.

Key words

Bacteria, yeast, virus, protein, DNA, interaction, signal transduction, molecular evolution, gene expression, cell biology, molecular biology, reactive oxygen species, ethanol

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