REVIEW THE ORGANISATION AND MANAGMENT OF GENOMES IN BACTERIA

2003

Foreword:

Microbial genetics are critical because genes form the fundamental constituent of a cell function and microorganisms are excellent tools for studying gene function. This paper will be reflecting on the characteristic features of genomes and its influence on the bacterial life cycle.

I will be furnishing a brief note on the concepts from a scientific angle and the views captured will be limited within the purview of the topics researched.

The apparently simple process of bacterial growth and division needs an impressive orchestration of various functions. Cells monitor and coordinate Deoxyribonucleic acid (DNA) replication with cell division to ensure that each progeny cell picks up an accurate copy of the genome. Optimal growth requires regulation of the cell cycle with metabolic processes. In bacteria that undergo cellular differentiation, developmental effects are coordinated with growth and with the cell cycle. Complex regulatory networks must be in place to ensure the right coordination of these events, not only in bacteria but in all organisms (Amick, Jean D and Brun, Yves V 1).

In bacteria, the gene transfer that leads to recombination can occur by three scientific mechanisms - transformation, transduction, or conjugation.

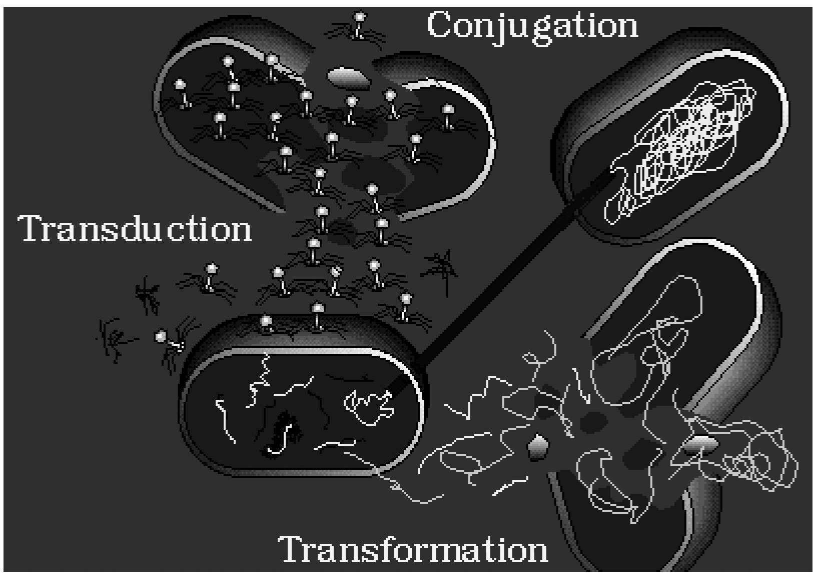

Fig 1. Mechanism of Gene Transfer, <u>On-line Course in Medical Bacteriology</u> 1995 November.

Transformation involves the ingestion by a recipient of free or naked DNA released from a donor. However, cells may only be physiologically adequate to take up DNA. Competence is related to alterations in the cell surface that gives leverage for strong binding of DNA. In certain organisms, such as E. coli, the transformation process can be heightened by special pre-treatment of cells. The cell is capable of undergoing electroporation where small holes or pores are open in the cell. A single strand of the transforming DNA is amalgamated into the chromosome utilizing common recombination mechanisms (Introduction 1).

Transduction is a process in which the transferred DNA is channeled in the capsid of a bacteriophage. The donor's DNA supplants part or all of the viral genome in the phage head. Thus, the particle is probably defective in viral replication because crucial viral genes are lacking. Specialized transduction, effects in transducing a few special bacterial genes. Generalized transduction can transfer any bacterial gene to the recipient. This process may occur with phages that degrade their host DNA into pieces the size of viral genomes (Introduction 1).

Conjugation, the third means of gene transfer is arbitrated by special genetic elements called plasmids. While plasmids are DNA, they control their own replication individually from that of the chromosome. The presence of plasmids in cells can be detected by techniques that assort them from chromosomal DNA. Some have genes that can direct their transmission from one cell to another by the process of conjugation. Also, plasmids may have genes that bestow novel phenotypes on cells, such as resistance to antibiotics, production of toxins, or the capacity to metabolize unusual substrates such as pesticides or industrial solvents (Introduction 1).

Another specific type of genetic rearrangement is the inversion of a DNA segment in the genome. This has regulatory significance if the segment comprises of a promoter. The orientation of the promoter fixes the direction in which mRNA synthesis will occur. Therefore, inverting a promoter sequence leads to expression of a dissimilar gene. This mechanism is responsible for alterations in the type of flagellar protein produced by Salmonella.

The genetic transfer mechanisms discussed above have been employed to map the order of genes on bacterial chromosomes. Interrupted mating was of value in a crude way for determining gene order, because large DNA segments can be transferred in conjugation. To accurately ascertain the order of closely linked genes, transduction has been most useful, because small DNA pieces are transferred.

Examining cell cycle-regulated protein expression and degradation by using a global proteomics approach has provided fresh insights into the complexity of the bacterial cell cycle. The circumstantially large number of proteins synthesized at a specific stage of the reproductive cycle hints that periodic protein expression is critical for the cell either to guarantee the optimal utilization of resources or to maintain the proper order and functioning of the cell cycle. Differentially expressed proteins were found to be involved in many dissimilar aspects of the cell's metabolism. A large subgroup of periodically synthesized proteins was of unknown subroutine and represent candidates for novel regulators of the C. crescentus cell cycle. The firm correlation between protein turnover and differential synthesis argues that one of the main reasons for rapid protein degradation in bacteria is to maintain the periodicity needed for ordered cell cycle progression. This is, to our knowledge, the foremost evidence for a global role of proteolysis in bacterial cell cycle control.

The findings of the brief study proposes that specific and controlled proteolysis plays a similar role in bacteria. It will be of special interest to find out the identity of all proteins found to be both unstable and differentially expressed, as some might have critical functions in cell cycle progression.. In an age of reemerging bacterial diseases, extensive knowledge of all regulatory processes involved in bacterial proliferation will be indispensable for the development of novel antimicrobial strategies.

Works Cited

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