MODELS FOR DNA MEDIATED BACTERIAL TRANSFORMATION

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1. Introduction

The process of DNA mediated bacterial transformation, originally described by Griffiths in 1928 and later clarified by Avery, Macleod, and McCarty [1] (for a recent review see [25]), provides the most direct evidence that DNA is the genetic material. It can be used to study the relation between the physical and chemical properties of DNA and its biological activity. Of particular interest are the biological effects of physical and chemical treatments of DNA and the study of the mechanism of genetic recombination at the molecular level. Transformation was first described in *Pheumococcus* and subsequently in a limited number of other bacterial species notably *Hemophilus influenzae* and *Bacillus subtilis*. In a typical transformation experiment specially prepared "competent" recipient bacterial cells of the strain x^-, requiring, say, a substance x, are mixed under suitable conditions with a donor DNA purified from a strain x^+ which does not require substance x. Among the DNA treated cells, a small proportion of "transformed" cells are found which no longer require substance x. It is now well established that this "transformation" of x^- to x^+ cells is mediated solely by the purified x^+ DNA.

The total amount of DNA per nucleus in, for example, *B. subtilis* corresponds to a molecule containing approximately 2×10^6 nucleotide pairs, or 2000 genes, assuming an average size of 1000 nucleotide pairs per gene. The DNA preparations used in transformation experiments generally contain molecules with an average size of 3×10^4 to 5×10^4 nucleotide pairs which corresponds to between one and three per cent of the complete bacterial chromosome. The procedures for preparing DNA break the chromosome, probably at random, into some 30 to 100 fragments. The size distribution of fragments within any given preparation may have quite a large variance. The lesion in the x^- cells, which prevents their growth in the absence of substance x, will generally be a genetic mutation affecting one (or possibly a few) nucleotide pairs at some defined point on the chromosome. Thus, only a fraction of the DNA molecules in a normal preparation will carry those nucleotide pairs involved in the x^-x^+ genetic difference.

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