Biochimica et Biophysica Acta, 1117 (1992) (1992) 237–242

BBAGEN 23725

The structural and functional organization of the baseplate distal part of T4 bacteriophage

A.A. Khusainov, A.A. Deev and G.R. Ivanitsky

Institute of Theoretical and Experimental Biophysics, Russian Academy of Science, Pushchino (Russia)

(Received 10 February 1992)

Key words: Bacteriophage; Baseplate; Structural organization; Recognition; Infection process; DNA ejection; Electron microscopy; Image processing

The structural organization of the baseplate distal part of bacteriophage T4 has been studied. The investigations resulted in revealing the functional role of gene products '11' and '12' in the course of baseplate reorganization and DNA injection. A new model of 'arrangement' of gp12 in the intact particle is suggested. A functional interrelationship between long fibers of the phage and the protein complex of baseplate distal part has been established.

Introduction

T4 baseplate is known to be a key structural element determining the high specificity of the process of bacteriophage interaction with 'host' cells [1]. The products of at least 18 different genes are known to compose the 'skeleton' and distal part of the baseplate [2].

When the cell is infected, the T4 tail and baseplate are reorganized. A baseplate undergoes some essential changes being transformed from a compact hexagon into a star [3–5]. This process, being a subsequent modification of the baseplate elements, can be induced artificially, in vitro, when affecting bacteriophage with various physical and chemical agents (urea, pH, temperature, etc.) [6,7]. The information about T4 interaction with 'host' cells and/or about affection of physical and chemical agents gets to the baseplate through two 'channels': (i) a 'channel' of long tail fibers constituting a complex of long tail fibers and the product of gene '9' (gp9). The protein is located in baseplate 'skeleton' [3]: (ii) a 'channel' of short tail fibers, being a complex of proteins (the products of genes '10', '11', '12'). They are proteins of the distal part of the baseplate [3–5].

The structural organization and functioning of the complex consisting of long fibers and gp9 were investigated in detail in Refs. 8–10. It was shown that the informational signal transmitted through the 'channel' of long tail fibers is principal for initial stages of the infection process. The long tail fibers are likely to induce a set of reversible conformational changes in the baseplate preceding its reorganization [8,10].

Unfortunately, the complex of proteins forming the distal part of the baseplate is little studied from the view-point of structure and functioning. As established earlier, gp10 and gp11 form tail pins of T4 baseplate. The gene '12' product forms thin fiber-like structures (short tail fibers), by which the phage interacts with cell receptors at late stages of infection [3,11]. These structures are about 35 nm long according to electron micrographs of free gene 12 products [12]. In intact bacteriophage gp12 is seen as compact structures between the projecting tail pins [3].

As a result of the high exchangeability of distal part proteins there is still no model of the structural organization of the baseplate that is acceptable from the view-point of experimental data. The functional role of each of its components is not determined either. We have no detailed information about the functional interrelationship between 'channels' of long and short tail fibers in the process of triggering of baseplate transformation [13,14].

To elucidate the role of baseplate in recognizing and infecting the 'host' cells by bacteriophage particle, we investigated in this work both the structural and functional organization of proteins of the T4 baseplate distal part.

Materials and Methods

Bacteria. Escherichia coli B, Bts/4 and CR63 were obtained from V.V. Mesyanginov and V.I. Tanyashin.

Phage. The strain T4B that requires the presence of L-tryptophan in the medium for unfolding of long tail

Correspondence to: A.A. Khusainov, Institute of Theoretical and Experimental Biophysics, Russian Academy of Science, Pushchino, Russia.