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Effect of thermoinduced changes in T4 bacteriophage structure on the process of molecular recognition of 'host' cells

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By means of high-precision acoustic measurements and by methods of fluorescent and electron microscopy, investigations have been performed of thermoinduced conformational changes in T4 bacteriophage and its thermolabile mutants altered in baseplate proteins (gene products 7, 8, 10). A relationship was found between the conformational changes in T4 bacteriophage structure in the temperature range of 33–45 °C and the efficiency of bacteriophage adsorption and the changes in the orientation of long tail fibers. The possibility of heat regulation of 'recognition' of 'host' cells by bacterial viruses is suggested.

Introduction

The essential feature of infection of cells by bacterial viruses is that it can take place only in living cells during their active growth. Therefore, the viral infection is very sensitive to the environmental changes that influence the metabolism activity of the 'host' cells. Temperature is one of these parameters.

It is well known that heating can induce morphological changes in T4 bacteriophage structure which are similar to those taking place during virus infection in vivo: unfolding of long tail fibers, expansion of a baseplate, a sheath contraction, DNA ejection [1–3]. Jamamoto and Uchida [1] have shown heating T4 bacteriophage to be able to induce two forms of tail reorganization: normal reorganization similar to changes which occur during an irreversible adsorption of phages in vivo; an aberrant reorganization when a tail contracts with a baseplate detached. The aberrant reorganization of T4 bacteriophage investigated in details in the works [2–5].

Moreover, in the phage structure transitions without morphological changes can occur [6]. These transitions can be induced by heating. Thermolabile mutants of T4 phage are suitable objects for investigation of thermoinduced conformational changes in bacteriophage structure. Goldberg [3] studied the role of some baseplate proteins of the T4 in the thermoinduced tail reorganization using thermolabile mutants of this bacteriophage. He showed that these mutants altered in baseplate proteins undergo normal morphological changes more easily than wild-type phage and some of them have an extended 'host' range. It was suggested that the mutants have low ability to recognize the 'host' cells. For these thermolabile mutants, Mesyanginov [7] showed that the orientation of the long tail fibers (an element of the phage structure which is very important for 'host' cell recognition) depended on the conformational changes of some baseplate proteins. These results bear witness to the importance of thermoinduced changes in bacteriophage structure for recognition of bacterial cells by viruses.

Unfortunately, there are only few investigations devoted to conformational changes in bacteriophage structure within the physiological temperature range where infection processes in vivo occur. It is clear that these structural changes are very important for phage attachment to the cell surface and recognition of the 'host'. The attempt to study the conformational changes in the structure of T4 and T7 in this temperature range has been made by Shilnikov and Khusainov [6].

In the present study we investigated thermoinduced structural changes in thermolabile mutants of T4 in the

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