The nucleus-like shell takes part in the regulation of the phiKZ bacteriophage genome transcription

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The giant phiKZ bacteriophage has a unique transcription program independent from bacterial DNA-dependent RNA-polymerase (RNAP). The two non-canonical multisubunit phage RNAPs transcribe the phage genome. The first one, called virion RNAP (vRNAP), is injected into the cell together with phage DNA and transcribes early genes. The second one, non-virion RNAP (nvRNAP), is produced in the bacterial cell during infection and transcribes late genes (previously published in: Yakunina M. et al. (2015) 43, 59295). Recently, it has been shown that during infection, the phiKZ bacteriophage forms a proteinaceous shell in the bacterial host cell (previously published in: Chaikeeratisak V. et al. (2017) Cell Rep 20, 1563–1571). The phage DNA is packed inside that nucleus-like shell (previously published in: Danilova Y.A. et al. (2020) Viruses 12, 1197). In this work, we investigated the localization of both phage RNAPs in the Pseudomonas aeruginosa cell during infection using methods of immunology, fluorescence and electron microscopy. We found that the number of early transcripts decreases to the middle of the infection cycle, but the amount of vRNAP increases by two orders of magnitude at the same time. The vRNAP is demonstrated to localize outside the shell in the second part of the infection. Apparently, the vRNAPs are separated from phage DNA and could not bind to their promoters. NvRNAP is transferred into the shell where all phage DNA is located to perform the transcription of the late genes. It seems that the phage DNA compactization inside the shell is important for late transcription initiation by nvRNAP. Based on our data, we suppose that the nucleus-like shell plays a great role in phiKZ genome transcription regulation. The work was supported by the Russian Science Foundation grant № 19-74-10030.