During infection, T7 DNA is transcribed first by the host RNA polymerase and then by newly made T7 RNA polymerase. T7 RNA polymerase has a stringent specificity for its own promoters, which are not found in host DNA. Therefore, production of the new T7 RNA polymerase, together with inactivation of the host RNA polymerase, switches all transcription from host DNA to T7 DNA. An initial wave of transcription proceeds down T7 DNA from left to right, taking about 40% of the latent period to reach the right end of the DNA. This wave may be coupled to entry of the DNA into the cell, and the mode of entry may be an important factor in controlling gene expression. Primary transcripts are cut at specific sites by a host enzyme, RNase III, to generate the mRNAs observed in the cell. The RNase III cleavages leave relatively stable base-paired structures at the 3' end of most T7 mRNAs, which may be at least partly responsible for the unusual stability of T7 mRNAs relative to typical host mRNAs. Differences in translational efficiency among the different T7 mRNAs are also important in regulating gene expression during infection.

INTRODUCTION

T7 is a virulent bacteriophage that infects Escherichia coli. It rapidly takes over the metabolism of the host cell and produces as many as 250 new phage particles in as little as 13 min at 37 °C. In order to generate high levels of T7 gene products in such a short time, the T7 mRNAs must be efficiently synthesized and translated. This review summarizes our current understanding of the strategies T7 employs to accomplish this.
GENETIC ORGANIZATION OF T7 DNA

T7 contains a single molecule of linear, double-stranded DNA that is almost 40,000 base pairs long. The nucleotide sequence of T7 DNA has been completely determined, and the coding sequences for all of the known and potential T7 proteins have been located in the nucleotide sequence (1-3). Fifty genes are closely packed but essentially nonoverlapping in the DNA, and more than 90% of the nucleotide sequence is used to code for proteins. The arrangement of these 50 genes in T7 DNA is shown in Figure 1. In addition, there may be as many as five genes having a coding sequence that overlaps one of the 50 closely packed genes in a different reading frame. T7 genes are numbered according to their relative positions in the DNA, the numbers increasing from left to right; for historical reasons, the integers 1 to 19 are used, as well as various decimal numbers from 0.3 to 19.5.

FIGURE 1. Genetic and physical map of T7 DNA (1,3). The positions of the terminal repetition (filled boxes), the T7 genes (open boxes), the promoters for T7 RNA polymerase (φ), and the terminator for T7 RNA polymerase (Tφ) are drawn to scale according to their locations in the nucleotide sequence. The gene number and function are indicated for some of the genes.