

DOI:
10.1038/nrm2382

 GENE EXPRESSION

Translation in real time

Because the dynamics of ribosomes are stochastic, it is necessary to analyse a single ribosome to study the step-by-step translation of messenger RNA. Wen *et al.* stalled a single ribosome at the 5'-end of a hairpin-shaped mRNA molecule, which was held by optical tweezers. This enabled the authors to measure translation in real time and assess the progress of translation by determining the size of the residual hairpin.

Translation is not a continuous process; it follows a repeated translocation and pause pattern. Each translocation event has a step size of ~3 bases (or one codon) and occurs in less than 0.1 second. The short intrinsic pauses between translocation events last ~2.8 seconds and are interrupted, as translation continues, by longer pauses, which can last 1–2 minutes and which may be important for translation regulation.

Analysis of the translocation times revealed that there are three identical substeps in each translocation step. One possible explanation is that the ribosome moves over the length of one codon with three single-base substeps. The authors also demonstrated that pause lengths, and thus the overall rate of translation, depend on the secondary structure of the mRNA; applied force from the optical tweezers destabilizes the secondary structure of the mRNA and decreases pause durations, but does not affect translocation times.

This study provides a first glimpse of the process of translation by a single ribosome. It will be interesting to do similar studies with templates that resemble more naturally occurring mRNAs.

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ORIGINAL RESEARCH PAPER Wen, J.-D. *et al.*
Following translation by single ribosomes one codon at a time. *Nature* 7 March 2008
(doi:10.1038/nature06716)