A model for the tryptophan mediated tailfiber extension of bacteriophage T6

J.G. de Boer, J. Greve, Joh. Blok.

Physics Laboratory of the Free University, Department of Biophysics, Amsterdam.

The T-even bacteriophages (T2, T4 and T6) have 6 long fibers that are attached to the end of the tail. The fibers may be in a retracted conformation, folded back along the tail, or in an extended conformation, in which case adsorption to host bacteria becomes possible. In some strains of T4 and T6 the aminoacid L-tryptophan (Trp) is required for fiber extension.

We studied the reaction of phage T6 with Trp in 50 mM phosphate buffer pH 7.0 by measurements of transient electric birefringence (which gives the rotational diffusion coefficient D_r), sedimentation coefficient and biological activity. For particles with retracted fibers $D_r = 333\ sec^{-1}$ and s = 1060 S (corrected to the viscosity of water at 20°C). With extended fibers these values change to 167 sec^{-1} and 850 S respectively.

At 20°C and intermediate concentrations of Trp insufficient to produce a saturation of the fiberextension phenomenon, a bimodal decay of birefringence was found that could only be described consistently by assuming a mixed population of particles with fibers either extended or retracted. Such a bidispers population was also found at high concentrations of Trp if the temperature was lowered to 10°C. Furthermore it was found that the assumption that the presence of Trp is a necessary requirement for fiberextension is incorrect. Part of the particles extend their fibers at higher temperature (40-50° C) even in the absence of Trp. This was confirmed by the finding that at this higher temperature a biological activity is found in the absence of Trp.

A quantitative model is presented based on the assumption that at each Trp concentration there exists an equilibrium between the two conformations (fibers-in and fibers-out). This equilibrium is governed by the affinity of each of six accepter sites for Trp which is different for the fibers-in and fibers-out conformation. Contrary to earlier models (1) this model predicts a certain probability of fiberextension in the absence of Trp.

1. Kellenberger, E., Bolle, A., Boy de la Tour, E., Epstein, R.H., Franklin, N.C., Jerne, N.K., Reale-Scafati, A., Séchand, J. (1965) Virology 26, 419.