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DNA interaction with freestanding cationic lipid bilayers

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We study the interaction of ds-DNA molecules with freestanding and supported cationic lipid bilayers.

DNA fragments of different lengths (5, 10, 20, and 48 kbp) were adsorbed on lipid membranes consiting mainly of zwitterionic DOPC with added fractions of cationic DOTAP (1…10 %). Freestanding bilayers were modeled using giant unilamellar vesicles of sizes >100 μm. Supported lipid bilayers were deposited on a mica support. To use the electrostatic interactions between DNA and membranes, experiments were carried out in deionized water.

Upon adsorption onto supported cationic bilayers DNA molecules behave as 2D random coils, in agreement with observations previously reported in the literature [1].

A completely different picture is observed when DNA molecules are adsorbed on freestanding cationic bilayers: Depending on the DNA fragment length and the fraction of cationic lipid in the membrane, the adsorbed DNA molecules collapse from the coil conformation (gyration radius of ca. 2 μm for 48 kbp DNA) into a globule with a size below the optical resolution limit (gyration radius of ca. 0.3 μm). The DNA globules stay attached to the bilayer and exhibit translational Brownian motion on the membrane with a diffusion coeffcient of 0.5 $\mu m^2/s$ corresponding to the size of 250 nm, in agreement with the dimensions expected for globules produced upon DNA condensation.

We present results of a systematic study of this phenomenon as a function of the DNA fragment length and cationic lipid membrane composition using fluorescence video microscopy with single particle tracking.

References

[1] B. Maier, J.O. Rädler, Phys. Rev. Lett. 82(1999) 1911.