Biochemistry, 40, 13644 - 13651 (2001).

DNA Condensation by Polyamines: A Laser Light Scattering Study of Structural Effects.

Veena Vijayanathan, Threia Thomas, Akira Shirahata(白幡 晶), and T. J. Thomas

Department of Medicine, Department of Environmental and Community Medicine, University of Medicine and Dentistry of New Jersey - Robert Wood Johnson Medical School, New Brunswick, New Jersey 08903, and Department of Biochemistry, Faculty of Pharmaceutical Sciences, Josai University, Skado, Saitama 350-02, Japan

To elucidate the structural features of polyamines governing DNA condensation, -DNA by spermine and a series of its homologues, the collapse of $H_2N(CH_2)_3NH(CH_2)_{n=2\cdot12}NH(CH_2)_3NH_2$ (n=4 for spermine) was studied using static and dynamic light scattering techniques. In 10 mM sodium cacodylate buffer, the EC50 values for DNA condensation were comparable $(4 \pm 1 \mu M)$ for spermine homologues with n = 4 - 8, whereas the lower and higher homologues provoked DNA condensation at higher EC50 values. The EC50 values increased with an increase in the monovalent ion (Na⁺) concentration in the buffer. Dynamic light scattering measurements showed the presence of compact particles with hydrodynamic radii (Rh) of about 40 - 50 nm for compounds with n = 3 - 6. Rh increased with further increase in methylene chain length separating the secondary amino groups of the polyamines (Rh = 60 - 70 nm for n = 7 - 10 and >100nm for n = 11 and 12). Determination of the relative binding affinity of polyamines to DNA using an ethidium bromide displacement assay showed that homologues with n = 2 and 3 as well as those with n > 7 had significantly lower DNA binding affinity compared to spermine and homologues with n = 5 and 6. These data suggest that the chemical structure of isovalent polyamines exerts a profound influence on their ability to recognize and condense DNA, and on the size of the DNA condensates formed in aqueous solution.