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

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To elucidate the structural features of polyamines governing DNA condensation, the collapse of λ -DNA by spermine and a series of its homologues, $H_2N(CH_2)_3NH(CH_2)_{n=2-12}NH(CH_2)_3NH_2$(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±1 μM) 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 >100 nm 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.