DNA CONDENSATION REVISITED: SPERMIDINE-INDUCED NOVEL DNA NETWORKS ON MICA SURFACES

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Spermidine, a trivalent polyamine cation, is ubiquitously present in the cytoplasm of cells. Under low ionic concentrations, spermidine condenses DNA into dense structures, which have been studied to understand the packaging of viral DNA. Spermidine and other naturally occurring polyamines play important roles in DNA stability, and gene transcription regulation. Earlier studies on DNA condensation with spermidine have reported the formation of rods, globular structures and toroid-like formations. We report for the first time, the formation of DNA network condensates induced by spermidine. The networks were formed on mica surfaces and involve hierarchical structures of parallel and coiled DNA fibers. Atomic force microscopy (AFM) imaging of the networks show a rich pattern of DNA fiber branching. The networks arise under certain combinations of DNA to spermidine concentration ratios and incubation times. These structures originate in solution where spermidine can induce multiple DNA molecules to coil around each other. Under most conditions, consistent with previous studies, DNA is seen forming tight globular structures that aggregate to form more complex branched structures, rods and partial toroids. The variety of observed structures and the sensitivity of the condensation pathway to concentration ratios and incubation times points to as yet unexplored regions in the DNA condensation phase diagram.