Triple Helices Formed by Polyuridylic Acid with Some Amino Deoxyadenosine Derivatives

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Summary. The stability of helical structures formed by polyuridylic acid with nucleosides and nucleotides derived from adenosine is not significantly affected by replacing hydroxyl groups by hydrogen, amino, or azido functions. Stability is affected by the position of the phosphate group.

Key words: Polyuridylic Acid/Triple-Helix Formation/Melting Temperatures/Amino Deoxynucleotides

INTRODUCTION

In an earlier paper (Shim et al., 1975) we described our efforts to prepare adenosine derivatives that would form organized structures with polyuridylic acid (poly U) even at temperatures well above the melting point of the adenosine-2 poly U triple helix. We found that a variety of polyamine derivatives of adenosine-5'-phosphate (pA), despite their apparently favorable net positive charge, form triple helices not much more stable than the helix formed by pA itself. We have now prepared 2'-amino-2'-deoxy-adenosine-5'-phosphate and 5'-amino-2'-5'-dideoxyadenosine-3'-phosphate and a number of related compounds, and have studied the melting behavior of the helices that they form with poly U. We expected that ionic bonding between NH$_3^+$ and PO$_4^{2-}$ groups within the triple helix would lead to an exceptionally stable structure. Our detailed results show that this expectation is not fulfilled.

MATERIALS AND METHODS

Materials

Poly (U), sodium salt, was prepared by a modification of a published procedure (Steiner & Beers, 1958). The synthesis of
the amino- and azido-deoxynucleosides and nucleotides will be described elsewhere. All other monomers were obtained from Sigma Chemical Co., St. Louis, Mo. Nucleotides were used as their ammonium salts. All compounds appeared homogeneous in a variety of chromatographic and electrophoretic systems (Shim et al., 1975).

Methods

Thermal transitions were monitored by UV measurements at 262 mμ with a Cary 14 spectrophotometer attached to a Honeywell 560 XY recorder (Renz et al., 1971). The temperature was changed at a maximum rate of 0.5°/min. Under these conditions heating and cooling curves were superimposable. Tm values (melting points) were reproducible within ±1°, and hypochromicities within ±2%. Measurements were made in solutions at pH 7.5, containing 0.05 M poly (U), 0.025M monomer, and 0.2M NaCl. These solutions gave a maximum optical density of 0.96 - 0.98 for a path length of 12 μm. In many cases, measurements were also made with a 25 μm cell. Maximum optical densities (observed at 40°C) were within 5% of the value calculated by summation of the optical densities of the components.

RESULTS

The melting points and hypochromicities of the helices formed by poly U with adenosine derivatives of the type

are given in Table 1.

DISCUSSION

5'-Amino-2',5'-dideoxyadenosine was found, by titration, to have a pK of 9.1. Thus in our experiments this compound should have been present as the zwitterion