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Stabilizing G-quadruplex DNA and RNA structures with ionic liquids

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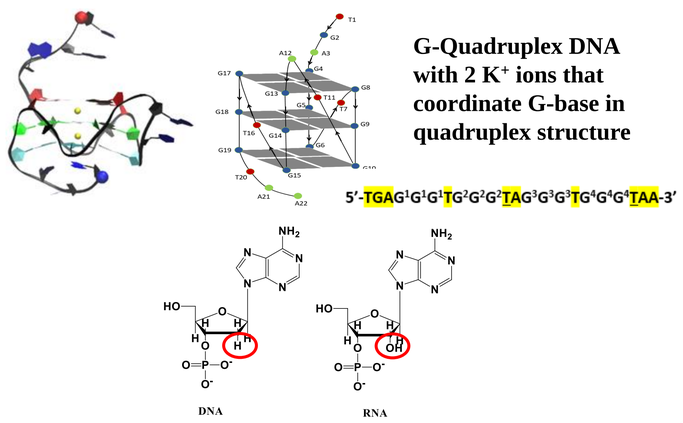
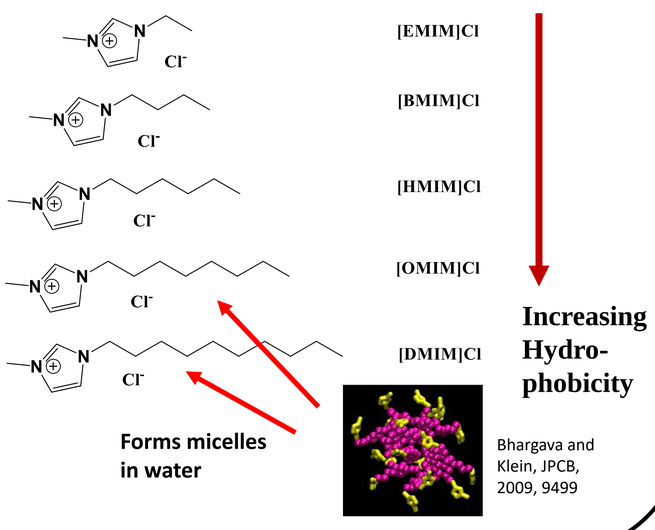
Summary / Abstract:

Stabilizing DNA and RNA for long-term room-temperature storage is important for many biotechnological applications including oncology pharmaceuticals and mRNA-based vaccines (e.g. Covid vaccines). This poster shows that **ionic liquids can improve the thermal stability of G-quadruplex DNA and RNA structures,** and motivates further studies of ionic liquid-based materials for DNA / RNA stabilization

G-Quadruplex DNA and RNA: Guanine-rich segments that form quadruplex structure rather than double-helix



Imidazolium Chloride Ionic Liquids:
Amphiphilic materials with broad applications in technology



G-Quadruplex DNA loses stability when K^+ is removed

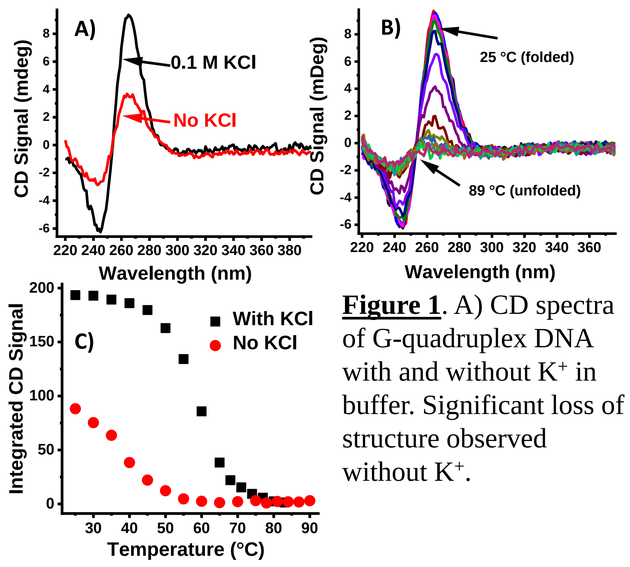


Figure 1. A) CD spectra of G-quadruplex DNA with and without K^+ in buffer. Significant loss of structure observed without K^+.

B) CD spectra of DNA with K^+ versus temperature showing how CD can follow thermal unfolding.
C) Integrated CD signal versus temperature quantifies thermal unfolding and shows that loss of K^+ destabilizes structure of G-quadruplex DNA

Ionic liquids in aqueous solution stabilize G-quadruplex DNA without K^+

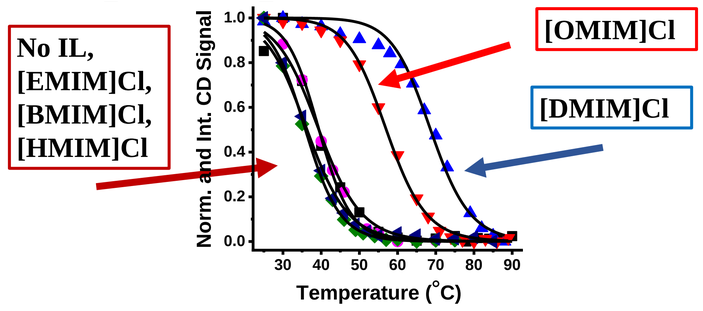


Figure 2. With the less hydrophobic ILs (notably, those that do not form micelles), G-quadruplex DNA remains thermally unstable. However, with the more hydrophobic ILs [OMIM]Cl and [DMIM]Cl (which form micelles), the DNA structure is stabilized as shown by increased thermal unfolding temperatures.

G-quadruplex DNA without K^+ stabilized by ionic liquids at high concentration, but NOT at IL CMC values

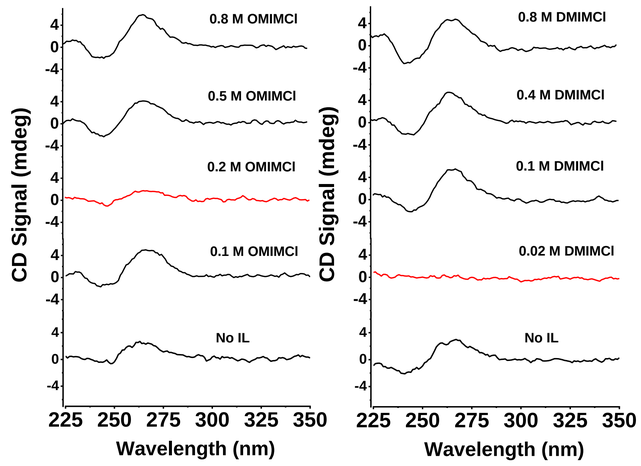


Figure 3. CD spectra of G-quadruplex DNA with increasing ionic liquid concentrations. The red spectra have ionic liquids exactly at their CMC values.

Ionic liquids only stabilize G-quadruplex RNA if K^+ is already present

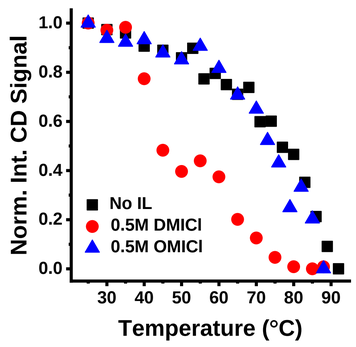


Figure 4. Thermal unfolding shows that without K^+ ILs do not stabilize G-quadruplex RNA

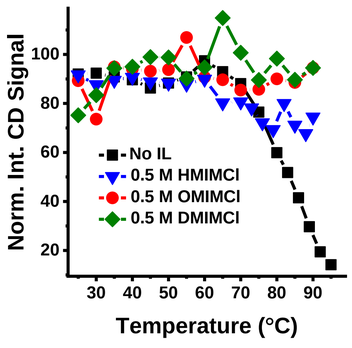


Figure 5. Thermal unfolding shows that with K^+ ILs significantly stabilize G-quadruplex RNA

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