An Investigation of the Thermostability of DNA polymerase using Molecular Dynamics Simulations

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Fundamentally, DNA polymerase functions as a means of replicating DNA within organisms. Since the invention of polymerase chain reactions (PCR) in the early 1980s, DNA polymerase has also become a critical tool in biotechnology. DNA polymerase I from *Thermus aquaticus (*Taq DNA polymerase) is an ideal prototype for PCR due to its thermostability and activity at high temperatures. Despite its unique stability at high temperatures, Taq DNA polymerase has its disadvantages. Its lack of a functional 3' to 5' exonuclease activity leaves it with a relatively high error rate. Also, Taq DNA polymerase often begins DNA replication at room temperature, resulting in mispriming and nonspecific products. As a means to improve its functionality as a PCR agent, Kermechiev and colleagues performed a series of random mutations on Taq DNA polymerase to reduce its activity at low temperatures. A mutation from isoleucine to leucine at residue 707 accomplished that goal. The mutation allowed for the Taq DNA polymerase to move even faster at higher temperatures than its wild-type counterpart. It is unclear, however, how exactly this mutation affects the activity of the polymerase at low temperatures. Molecular Dynamic studies using AMBER were performed on this mutated Taq DNA polymerase to study the difference between the protein-DNA complex at both low and high temperatures.