DYNAMICS AND MECHANISM OF EFFICIENT DNA REPAIR REVIEWED BY ACTIVE-SITE MUTANTS

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Photolyases repair the UV-induced pyrimidine dimers in damage DNA via a photoreaction which includes a series of light-driven electron transfers between the two-electron-reduced flavin cofactor $FADH^-$ and the dimer. We report here our systematic studies of the repair dynamics in $E.coli$ photolyase with mutation of several active-site residues. With femtosecond resolution, we observed the significant change in the forward electron transfer from the excited $FADH^-$ to the dimer and the back electron transfer from the repaired thymines by mutation of E274A, R226A, R342A, N378S and N378C. We also found that the mutation of E274A accelerates the bond-breaking of the thymine dimer. The dynamics changes are consistent with the quantum yield study of these mutants. These results suggest that the active-site residues play a significant role, structurally and chemically, in the DNA repair photocycle.