

Noncanonical prokaryotic X family DNA polymerases

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DNA polymerases of the X family (PolX) play essential functions in eukaryotic DNA repair. PolX polymerases are also found in prokaryotes but their diversity and functions remain largely unstudied. We have performed a comprehensive bioinformatic analysis of prokaryotic PolXs and found that they are widespread in bacteria and are also present in several archaeal lineages. Most polymerases share a common architecture, with the central polymerase part consisting of the thumb, palm and fingers domains, preceded by an N-terminal dRP-lyase domain and followed by a C-terminal exonuclease PHP domain. Unexpectedly, we have revealed a previously unrecognized group of noncanonical PolXs that seem to be lacking DNA polymerase activity. They contain substitutions of key catalytic residues and deletions in their polymerase and dNTP binding sites in the palm and fingers domains, but contain a functional exonuclease domain. Biochemical experiments with representative noncanonical PolXs from the *Deinococcus* genus confirmed that they are indeed inactive as DNA polymerases but are highly efficient 3'-5' exonucleases. The biological function of altered polymerases is possibly connected with double-strand break DNA repair, since both canonical and altered PolXs are often encoded together with the components of the non-homologous end joining pathway, suggesting an evolutionary conservation of this PolX function. This is a remarkable example of polymerases that have lost their main polymerase activity, but may be involved in the nuclease processing of DNA repair intermediates.