
Rapid turnover of centromeric DNA reveals signatures of genetic conflict in *Drosophila*

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Abstract

Centromeres are chromosomal structures required for faithful genome inheritance during cell division. Centromeres are defined epigenetically by the presence of the centromere-specific histone H3 variant, CENP-A. While centromeres form in repeat-rich regions of the genome, the roles of DNA sequences in centromere function are unclear. We recently revealed that all centromeres in *D. melanogaster* correspond to islands of complex DNA enriched in retroelements and flanked by tandem repeats. Each centromere is unique—the only sequence they have in common is the *G2/Jockey-3* retroelement. It is unclear if any of these sequences are important for centromere function. Here we study the evolution of centromere composition to gain insights into the role of DNA sequence in centromere biology. We combined (epi)genomic and cytological approaches to characterize centromere organization in three sister species: *D. simulans*, *D. sechellia*, and *D. mauritiana*. We discovered dramatic centromere reorganization involving recurrent shifts between retroelements and satellite DNAs over short evolutionary timescales (< 240 Kya). None of the *D. melanogaster* centromere islands are conserved in the *simulans* clade. Instead, in the *simulans* clade centromeres are mainly composed of two complex satellites: *500bp* and *365bp*. Those two complex satellites are specific to the *simulans* clade, suggesting that they invaded and replaced centromeres after the split with *D. melanogaster*. In addition, we observed a second replacement event specific to *D. sechellia*, where the dot and X chromosome centromeres now sit on telomere-specific retroelements, revealing for the first time true telocentric chromosomes. Finally, *G2/Jockey-3* is enriched in *D. simulans* centromeres, but much less so in *D. sechellia* and *D. mauritiana*. Identifying the functional centromeric DNA shed new light into their roles in chromosome function and evolution. Our results highlight the very rapid turnover of centromeric sequences among the *melanogaster* clade and are consistent with recurrent genetic conflict.

Keywords: centromere, genetic conflict, *Drosophila*, repeat sequences

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