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Emergence of novel retroelement-derived domesticated genes: a phylogenomic perspective

Abstract:
Transposable elements are mobile genomic elements that have an ability to move (transpose) and replicate in the genome of their host. Vertebrates possess numerous single copy domesticated genes (DGs) that have originated from the intronless multicopy transposable elements. Previous studies gained limited insight into phylogenetic relationships between different DG families, either due to insufficient taxonomic sampling or the analysis of a single DGs family only. We traced the genesis and regulatory wiring of the retroelement-derived DGs (RDDGs) through phylogenomic analysis, using whole-genome information from more than 90 chordate genomes. Phylogenomic analysis of the DGs in chordate genomes provided direct evidence that major diversification has occurred only in the ancestor of placental mammals. Mammalian RDDGs have been shown to originate in several steps by independent domestication events and to diversify later by gene duplications. Analysis of syntenic loci has shown that diverse RDDGs and their chromosomal positions were fully established in the ancestor of eutherian mammals. By analysis of active Metaviridae lineages in amniotes we have demonstrated that Eutheria-specific domesticated genes originated from retroelement remains. During the domestication process, *de novo* acquisition of the regulatory regions is shown to be a prerequisite for the survival of the DGs. The origin and evolution of *de novo* acquired promoters and UTRs in diverse mammalian RDDGs have been explained by comparative analysis of orthologous gene loci. The origin of the Eutheria-specific innovations and adaptations, such as placenta and newly evolved brain functions, was most probably connected to the regulatory wiring of domesticated genes and their rapid fixation in the ancestor of placental mammals.