Tissue-specific expression of heterozygous Z-inversions in the zebra finch

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Abstract

Chromosomal inversions have been identified in many natural populations and can be responsible for novel traits and fast adaptation. In zebra finch, an inversion in the Z chromosome has a pleiotropic effect on multiple traits but especially on sperm. Males heterokaryotypic for the inversion have sperm with a longer midpiece and higher velocity. They have higher fertility and siring success than homokaryotypic males. To understand the effect the Z inversion on these traits, we examined young males at different stages of testis development using two homokaryotypic lines and heterokaryotypes. We sampled both testis and liver tissue to identify gene expression differences. In testis, 520 differentially expressed genes were found and most of them were located on chromosome Z. They were functionally enriched for sperm-related traits. In liver, 420 differentially expressed genes were not enriched for any specific functions but showed also an overrepresentation on chromosome Z. In both tissues, this overrepresentation was located near the distal end of Z but also in the middle of the chromosome. For the heterokaryotype, we observed several genes with expression patterns more similar to one or the other karyotype, based on similarity to homokaryotype invidividuals. This was confirmed with SNPs for three genes, and interestingly one gene, dmgdh, had allele-specific expression originating from only one inversion-allele in the testis, yet both inversion alleles were expressed in the liver. This allele-specific difference in tissue-specific expression demonstrates a pleiotropic effect of the inversion and thus suggests a mechanism for divergent phenotypic effects resulting from an inversion.

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