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Satellite DNA-derived siRNAs and piRNAs: differential processing and induction of satellite DNA transcripts in the beetle *Tribolium castaneum*

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In the flour beetle *Tribolium castaneum* large blocks of (peri)centromeric heterochromatin contain long arrays of a major abundant satellite DNA TCAST1 interspersed with minor satellite DNAs. The satellites are in addition partially dispersed in the gene vicinity in euchromatin. We analyse expression and processing of a major and a minor *T. castaneum* satellite DNAs TCAST1 and TCAST2, respectively, during development, as well as in response to heat stress. The results show processing of TCAST2 transcripts exclusively into piRNA during all development stages. Apart from that, TCAST1 transcripts are preferentially in the form of piRNAs during embryogenesis, while in later development siRNAs are almost exclusively produced. This indicates difference in the processing of TCAST1 primary transcripts between germ line and somatic cells and suggests TCAST1 piRNAs production only in germ line. The two satellites also differ in response to heat stress, TCAST1 expression being strongly induced while TCAST2 expression is not affected. Also, the level of silent histone mark H3K9me3 at TCAST2 repeats is not changed after heat stress as well as expression of TCAST2-associated genes, contrary to the suppression of TCAST1-associated genes which correlates with the increased H3K9me3 level at TCAST1 repeats. We propose that variation in sensitivity to heat stress between the two satellites might be due to difference in piRNA-specified heterochromatin characteristic for a minor TCAST2 satellite and siRNA-specified heterochromatin characteristic for a major TCAST1 satellite. The results reveal distinct regulation of expression and processing of different satellite DNAs during development and upon environmental stress resulting in diverse roles their transcripts might play during these processes, specifically regarding heterochromatin establishment and maintenance, as well as modulation of expression of nearby genes.