The influence of development and heat stress on major and minor satellite DNA in the beetle *Tribolium castaneum*

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Background

- the transcription of satellite DNAs has been reported in many species and is often modulated during development, cell differentiation, or in response to environmental stimuli
- transcription of the major *T. castaneum* satellite DNA, TCAST1, depends on RNA polymerase II initiated from internal promoters, and the resulting long primary transcripts are processed into small RNAs
- siRNAs are 21–22 nt long and are derived from repetitive sequences and their role in heterochromatin establishment has been demonstrated in yeast, plants, and insects. However, piRNAs, which are ~26–30 nt long, mostly derive from transposon sequences, and their major role is to repress transposon activity at both the transcriptional and translational level

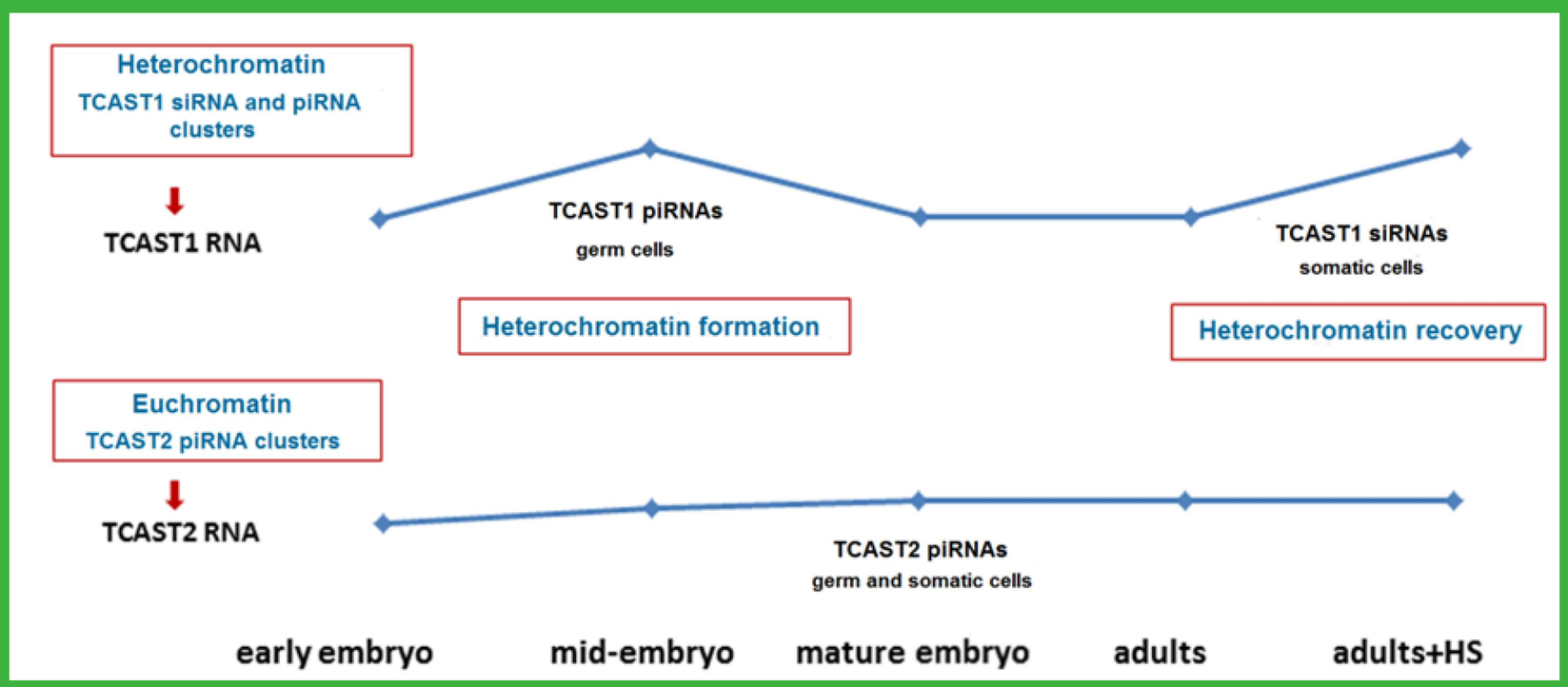
Methods

- RNA sequencing
- small RNA sequencing
- Chromatin immunoprecipitation (ChIP)

Results

- TCAST1 transcription was strongly induced at specific embryonic stages and upon heat stress, while TCAST2 transcription is stable during both processes
- TCAST1 transcripts are processed preferentially into piRNAs during embryogenesis and into siRNAs during later development, contrary to TCAST2 transcripts, which are processed exclusively into piRNAs
- increased TCAST1 expression upon heat stress is accompanied by the enrichment of the silent histone mark H3K9me3 on the major satellite, while the H3K9me3 level at TCAST2 remains unchanged

The major satellite DNA TCAST1 transcripts are differentially processed during development, preferentially into piRNAs during embryogenesis, and almost exclusively into siRNAs at later developmental stages, suggesting that TCAST1 piRNA production occurs in only the germ line. In contrast, the minor satellite DNA TCAST2 transcripts are processed exclusively into piRNA throughout all developmental stages.



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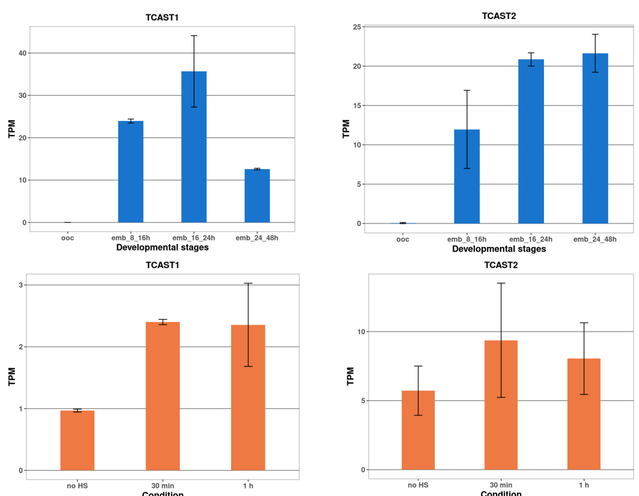
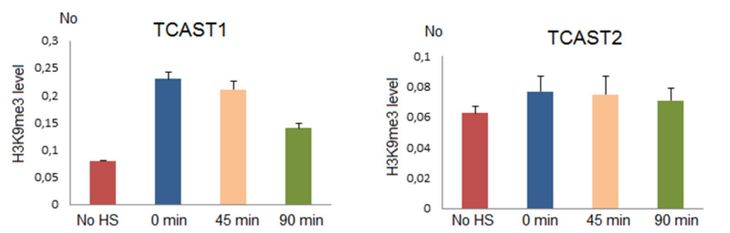
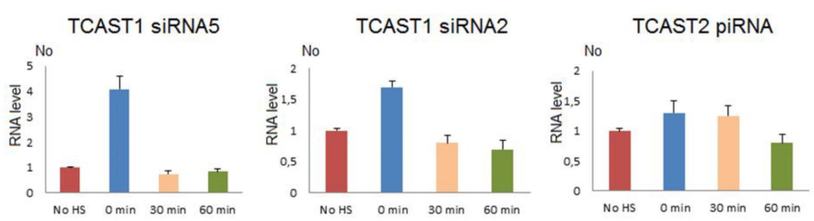
Extra Figures



Transcription dynamics of satellite DNAs TCAST1 and TCAST2 during phases of embryogenesis and in adults subjected to heat stress, after 30 min and 1 h of recovery as well as in control adults obtained from RNASeq data.



The level of H3K9me3 at TCAST1 and TCAST2 satellite repeats after heat stress. H3K9me3 levels were measured by ChIP coupled by quantitative real-time PCR at standard conditions (no HS), immediately after 24 h of HS (0 min), at 45 min and 90 min of recovery.



The dynamics of expression of TCAST1 siRNAs 5 and 2, and of TCAST2 piRNA in beetle *T. castaneum* adults under standard conditions (no HS), immediately after 24 h of heat stress at 40 °C (0 min), at 30 min and 60 min of recovery.