URLs

CIRCADIAN GENETICS

Heating up the body clock

Although light is thought of as the main cue that drives circadian rhythms, temperature is also important in adjusting the clock. Two studies now provide insights into how temperature feeds into the molecular pathways that underlie circadian clocks, revealing intriguing similarities and differences between species.

In *Neurospora crassa*, rhythmic expression of FREQUENCY (FRQ) is crucial for circadian function. Temperature affects the clock by driving a rhythmic ratio of expression of two distinct FRQ isoforms. Brunner and colleagues showed that this ratio is regulated by a temperature-sensitive splicing event, and that mutations that affect this event alter circadian rhythms of asexual spore production.

Temperature also regulates overall FRQ levels. The *frq* 5' UTR contains upstream ORFs that have non-consensus sites for ribosome binding and are translated inefficiently. However, their translation is increased at lower temperatures. This represses FRQ translation, probably by inhibiting ribosome binding downstream of the UTR, to provide another thermosensitive means of FRQ regulation.

In *Drosophila melanogaster*, circadian rhythms can be synchronized to a 24-hour cycle in the absence of light cues if there are cyclic changes in temperature. Glaser and Stanewsky showed that temperature can also induce rhythmic expression of two key clock genes — *period* and *time-*

less — through a post-transcriptional mechanism. Screening for mutations that abolish temperature-driven synchronization identified the *nocte* (no circadian temperature entrainment) gene. In addition, the authors showed that mutations in another gene, *norpA* (which encodes phospholipase C), have a similar effect.

NORPA was previously shown to be involved in the adjustment of *D. melanogaster* circadian rhythms to seasonal temperature variations by regulating *per* splicing. However, this does not seem to be important for the synchronization of rhythms, indicating that other mechanisms — probably post-translational ones — are involved.

As well as highlighting the post-transcriptional thermoregulation of gene expression as a conserved theme in circadian biology, these studies also raise some important questions. For example, what is the role of temperature in *N. crassa* circadian biology? Does it adjust rhythms to changing seasons or synchronize them to daily cycles — or, as in flies, does it do both?

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References and links

ORIGINAL RESEARCH PAPERS

Diernfellner, A. C. *et al.* Molecular mechanism of temperature sensing by the circadian clock of *Neurospora crassa*. *Genes Dev.* 17 August 2005 (doi:10.1101/gad.345905) | Glaser, F. T. & Stanewsky, R. Temperature synchronization of the *Drosophila* circadian clock. *Curr. Biol.* **15**, 1352–1363 (2005)

FURTHER READING

Bell-Pedersen, D. *et al.* Circadian rhythms from multiple oscillators: lessons from diverse organisms. *Nature Rev. Genet.* **6**, 544–556 (2005)