Siestas Among the Drosophilae

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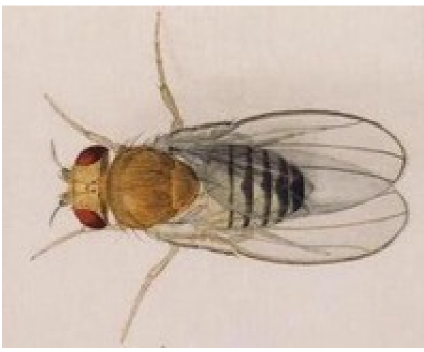

Drosophila melanogaster. Credit: Carnegie Institution of Washington publication

(PhysOrg.com) -- Isaac Edery is concerned with biological clocks, internal mechanisms that enable virtually all plants and animals to behave in rhythmic biological cycles known as circadian rhythms.

The internal clocks can be synchronized to daily and seasonal changes using external time cues, such as light and temperature. Edery says that this allows life forms to anticipate environmental transitions, perform activities at biologically advantageous times of day, and undergo seasonal responses.

His specific focus is on understanding the biochemical and molecular bases of these biological timekeeping devices. Edery uses the phenomenon of a circadian midday dip in activity or “siesta” among the fruit flies he studies as a prism through which to examine its biochemical underpinnings.

Edery, a professor in the Department of Molecular Biology and Biochemistry and a member of the Center for Advanced Biotechnology and Medicine, works with Drosophila melanogaster (the common fruit fly), a frequently used model organism for biological systems.

Jetlag and shift work can throw our own clocks out of synch while several human disorders may also be associated with out-of-adjustment clocks, including chronic sleep disorders, manic-depression and seasonal affective disorders (SAD or winter depression).

Circadian clocks are comprised of a specialized set of interconnected proteins whose production is governed by a number of “clock genes” that appear to operate in 24-hour cycles. Working with the key clock gene period (per), Edery has shown that splicing plays a major role in temperature-induced changes in the fly’s daily activities - namely its siesta.

Splicing is the removal of introns or noncoding sequences (regions in a gene that are not translated into proteins) during the transcription process (DNA to RNA). An increase in the number of splicing contacts on the RNA facilitates binding of the splicing machinery and hence increased splicing.

On seasonably hot days D. melanogaster undergoes a decrease in splicing of the terminal intron (the segment at the end of the per molecule) leading to a delay in the daily upswing in per RNA levels which prolongs its midday siesta. This can be interpreted as an adaptive response that likely diminishes the harmful effects of heat during the longer summer days in temperate climates.

Edery’s most recent work reported in the journal *Neuron* compares the siesta in different fruit fly species. He and his research team looked at melanogaster, with its wide distribution pattern from tropical to temperate regions, and D. yakuba that live only in equatorial regions where day length and temperature fluctuate little throughout the year.

In yakuba, they found that the splicing of the per terminal intron does not vary with temperature. This is consistent with the small effect of temperature on the daily activity schedule in yakuba which correlates with the year-round consistency in daylight and temperature. The reason for the species-specific differences in splicing is that the D. melanogaster per intron has weak contacts making the binding of the splicing machinery less stable at higher temperatures, whereas the splicing sites on the D. yakuba intron are so strong that the binding of the splicing machinery is similar over a broad range of temperatures.

Edery and his team concluded that in the widely colonized melanogaster, they had identified a mechanism that facilitates the acclimation to temperate climates not operating in the equatorial yakuba. The logical deduction is that natural selection operating at the level of splicing signals plays an important role in the thermal adaptation of life forms.

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