CIRCADIAN RHYTHMS

Meal time & mouse rhythms

Van der Vinne, V., Bingaman M.J., Weaver, D.R., & Swoap, S.J. *J. Exp. Biol.* **221**, jeb179812 (2018).

Every day for several weeks, Williams College undergraduate Mark Bingaman quietly entered a darkened room to deliver several mice their daily meal. The mice were being kept in total darkness and fed just once a day to test how the timing of food intake interacts with the internal circadian clock to influence torpor, a sluggish state in which animals like mice lower their body temperature and metabolic rate to save energy. Researchers have long suspected a link, says collaborator Vincent van der Vinne from the University of Massachusetts Medical School, but how the variables interacted wasn't clear.

Bingaman started off with a consistent schedule: he fed the six female wild-type C57BL/6J mice, implanted with temperature sensors, at the same time every 24 hours for 10 days. But then, it was time to shift the cycles. "Some days, feeding occurs in the middle of the day. But then a week later, feeding occurs in the middle of the night,"

says van der Vinne. "At the end of these experiments, he [Bingaman] was pretty exhausted."

The results, van der Vinne says, were worth the mid-night lab visits.

Even in darkness, a mouse's circadian clock is closely tuned to 24 hours and cycles between active and resting phases. A few hours after the mice were fed on the 24-hour cycle, they drifted into torpor, with their body temperatures dipping about 10 °C. But changing the feeding cycles to 20 or 28 hours disrupted those torpor bouts: the animals' environment wasn't syncing with their internal clocks, van der Vinne says.

If the mice ate during their circadian active phase, they would still enter torpor later, though the bouts were less pronounced if the meal came close to their internal switch from active to resting phases. When feeding coincided with when the murine clocks said it was time to cool down, torpor was entirely absent.

The team repeated the experiment with two transgenic mouse lines, one with a 28-hour clock and another with none at all. The 28-hour mice responded similarly to the wild-type animals, while clock-less mice regularly entered torpor about four hours after a meal regardless of when they were fed.

Torpor, the researchers conclude, is regulated by the circadian clock in a hungry mouse but can be influenced by the timing of food intake. Food means energy—if the mice are eating when they would otherwise be in or approaching a state of torpor per their circadian clock, there's really no need to save that energy and they can remain alert instead, van der Vinne says.

At least until the clock comes 'round again.

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