論文の内容の要旨

論文題目　Temperature compensation in circadian clocks via biochemical cooperation
（生化学協同作用による概日時計の温度補償性）

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Temperature compensation is a notable property of circadian oscillators that indicates the insensitivity of the oscillator system's period to temperature changes; the underlying mechanism, however, is still unclear. We investigated the influence of cooperative stability in protein degradation on the temperature compensation ability of oscillators. Here, cooperative stability means that high-order oligomers are more stable than their monomeric counterparts. The period of an oscillator is affected by the parameters of the dynamic system, which in turn are influenced by temperature. We adopted the Repressilator, Atkinson oscillator and Goodwin oscillator to analyze the temperature sensitivity of their periods. Furthermore, we used experimental data to determine the reasonable range of parameter temperature sensitivity. We then applied the linear programming method to the oscillatory systems to analyze the effects of cooperative stability on the temperature sensitivity of their periods, which reflects the ability of temperature compensation in circadian rhythms. Our study explains the reasons why the models considering cooperative stability can improve temperature compensation ability. Compared with the no-dimer mathematical model and linear model for protein degradation, our theoretical results show the nonlinear protein degradation caused by cooperative stability is more beneficial for realizing temperature compensation of the circadian clock.