Computational model for the mammalian circadian clock

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Abstract

In this poster we present a simplified model of the computational model of the mammalian circadian clock proposed by (Leloup and Goldbeter, J. Theor. Biol. 2004, 230, 541-562). This simplification is based on the negative feedback loop involving the Per and Cry genes, which play a crucial role in the dynamics of the mammalian circadian rhythm : This loop results in a 24 hour oscillation in the expression of protein levels. The period gene "per" and its protein product "PER" are essential components of the negative feedback loop and the cryptochrome gene "cry" in mammals acts together with the period gene in circadian rhythm regulation. Moreover, phosphorylation by several kinases complexifies the regulation of the per gene within mammalian cells. In mammals, the suprachiasmatic nucleus in the hypothalamus is considered to be a major pacemaker for circadian rhythm phenomena, as demonstrated by many physiological studies.

We found a set of parameter values that give rise to sustained oscillations with a circadian period. After comparing the effect of these parameters, we show that the period of the oscillations are generally most sensitive to parameters related to synthesis or degradation of PER and CRY protein. This study is an attempt to explore a minimum but biologically realistic prerequisite for a negative feedback loop to produce circadian oscillations.