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Avian biological clock - immune system relationship

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Abstract

Biological rhythms in birds are driven by the master clock, which includes the suprachiasmatic nucleus, the pineal gland and the retina. Light/dark cycles are the cues that synchronize the rhythmic changes in physiological processes, including immunity. This review summarizes our investigations on the bidirectional relationships between the chicken pineal gland and the immune system. We demonstrated that, in the chicken, the main pineal hormone, melatonin, regulates innate immunity, maintains the rhythmicity of immune reactions and is involved in the seasonal changes in immunity. Using thioglycollate-induced peritonitis as a model, we showed that the activated immune system regulates the pineal gland by inhibition of melatonin production at the level of the key enzyme in its biosynthetic pathway, arylalkylamine-N-acetyltransferase (AANAT). Interleukin 6 and interleukin 18 seem to be the immune mediators influencing the pineal gland, directly inhibiting *Aanat* gene transcription and modulating expression of the clock genes *Bmal1* and *Per3*, which in turn regulate *Aanat*.

Key words: pineal gland, chicken, immunity, peritonitis, seasonality, photoperiod

1. Introduction

The pineal gland, a neuroendocrine organ existing solely in vertebrate species, is involved in the control and synchronization of several behaviors and physiological processes through the circadian synthesis of its main hormone, melatonin (Falcon, 2007). Melatonin synthesized during the night is immediately secreted into the cerebrospinal fluid and into the blood where it circulates and acts as a signal to the body that it is dark, regardless of the diurnal or nocturnal pattern of the animal's locomotor activity (Challet, 2007). The role of the pineal gland in the regulation of functions varies according to species. In particular, there is a huge difference between mammals and birds in the importance of the pineal gland in

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