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Awakening a sleeping dogma: Diurnal changes in hypothalamic melatonin synthesis de novo in passerines

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Annual fluctuations in photoperiod, associated with seasonal availability of resources, mediate physiological and behavioral changes across vertebrate taxa. Variations in the duration of nocturnal melatonin secretion in temperate zones provide information about the time of day and year. Changes in photoperiod regulate gonadal growth and regression in seasonal breeders, and administration of melatonin has profound effects on mammalian gonadal status. Unlike in mammals, there is a long-standing dogma that pineal melatonin is not involved in avian seasonal reproduction, based on just a handful of experiments. Recent evidence suggests hypothalamic melatonin synthesis could well be involved in the timing of reproduction in birds. Our preliminary data indicate that passerine birds *Sturnus vulgaris* are likely to produce hypothalamic melatonin with diurnal fluctuations, causing us to reconsider the role of melatonin in avian seasonal reproduction. This project investigates if melatonin can be synthesized de novo in the avian hypothalamus by confirming the expression of all four enzymes of the melatonin biosynthesis pathway: tryptophan-5-hydroxylase (TPH), 5-hydroxytryptophan decarboxylase (DDC), aralkylamine N-acetyltransferase (AANAT), and hydroxyindole-O-methyltransferase (HIOMT). This is the first time the expression of these four enzymes has been identified in the songbird hypothalamus. By comparing the diurnal and nocturnal expression levels of these enzymes in the hypothalamus relative to other tissues known to synthesize melatonin de novo (i.e. the pineal and the retina), we demonstrate the potential for daily fluctuations of encephalic melatonin to influence avian photoperiodic responses. This will better our understanding of the crucial role of melatonin in the evolution of photoperiodic responses across vertebrates.

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