High production of retinal melatonin in constant darkness

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INTRODUCTION AND METHODS. The vertebrate retina produces melatonin (MEL), a putative neuromodulator which has been implicated in the regulation of various aspects of retinal physiology cued by day - night cycle (1,2). It has been demonstrated that the activity of serotonin N-acetyltransferase (NAT; a penultimate and key regulatory enzyme in MEL biosynthetic pathway) and MEL content of retina fluctuate throughout the day, with peak values at night (2). Although the daily rhythm of MEL production is thought to be a circadian one, relatively little is known about its course in retinas of living animals after long-time adaptation to darkness. Thus, the present work was aimed at studying the nature of MEL formation in retinas of dark-adapted chicks.

Experiments were performed on male white leghorn chicks. The animals were kept from the day of hatching under 12 h light: 12 h dark (LD) lighting schedule (lights on between 23:00 and 11:00; 300 lux), and then at the age of 12-16 days they were transferred to constant darkness (DD). The animals were killed by decapitation at sequential intervals; retinas were quickly isolated and frozen on dry ice. Tissues were stored at -70°C until assayed. NAT activity was determined by a radioisotopic method (3). MEL content was measured using a specific radioimmunoassay kit (DRG). Data are expressed as means ± SEM (n=5/group).

RESULTS AND DISCUSSION. Chick retina is characterized by large day-night variations in NAT activity and MEL content. At the beginning of the 4th and 7th h of the dark phase of the 12:12h LD cycle NAT activity displayed an approximately 5- and 7-fold increase, respectively, compared to the enzyme activity found at the end of the light phase (Fig. 1). MEL level in retinas dissected at 14:00 (dark phase) was 2.8-time higher than the level found in tissues isolated at 9:00 (light phase) (Fig. 2). The rhythm of NAT activity is circadian in nature. It freeruns in DD for up to 5 days, with activity decreasing during the subjective light phase, and increasing during the subjective dark phase (Fig. 1), and with a period close to 24 h (not shown). It should be noted, however, that the amplitude of the rhythm was markedly dampened with time, due primarily to the gradual and potent elevation of the enzyme activity during the subjective light phase. In line with this, on the 4th day of DD, MEL content of the retina at 14:00 represented only 123% of the compound level measured at 9:00, and, interestingly, both values were significantly higher than MEL levels found in retinas kept under LD cycle (Fig. 2). The pattern of oscillations in NAT activity, together with elevated levels of retinal MEL found at 4th day of DD, indicate that the adaptation of chicks to constant darkness results in high MEL production by retina. The obtained data may indicate an important role of MEL in adaptational processes of the retinal physiology to darkness.

Fig. 1. Rhythm of NAT activity in retinas of dark-adapted chicks.
Fig. 2. MEL levels in retinas of chicks adapted to LD and DD.


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