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Maternal photic regulation of immune status in neonates of Indian palm squirrel *Funambulus pennanti*

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Till date the phenomenon of maternal transfer of photic information was reported to regulate the fetal/neonatal growth, however its influence on neonatal immune system is still an enigma. In the present study, we observed an increase in maternal plasma melatonin level under short day length (SDL) condition with a consequent decrease in TLC and LC in their respective neonates. However, a significant decrease in maternal plasma melatonin level was noted under constant darkness (DD) with an increase in TLC and LC of their neonates. The blastogenic response (BGR) to Con A of splenocytes exhibited a significant increase in neonates of SDL females and a significant decrease in the neonates of DD females. Hence, it appears that the increase in maternal plasma melatonin under SDL condition transmitted information to decrease the immune status. Continuous exposure of females to darkness (DD) negatively regulated the maternal pineal gland activity thereby decreasing their plasma melatonin level. This information was transmitted for elevation of immune status in neonates, so that they exhibit better growth and sexual maturation. Therefore, we may suggest that the maternal photic information transmitted either prenatally through placenta or postnatally via the milk regulate the hormonal profile of Melatonin to regulate the immune status of neonates in order to influence their growth and sexual maturation.

Key words: Melatonin, photic, photopereiod, immune, *Funambulus pennanti*

Introduction:

The information about the daily photoperiod perceived by the pregnant females is transmitted either prenatally to the fetuses through the placenta or postnatally to the neonates via the milk [1,2]. Till date, the pineal gland and its hormone melatonin has been reported to be a prime candidate for the maternal transfer of photic information regulating the fetal/neonatal growth and sexual maturation [3]. However, no report exists for the maternal photic regulation of the immune status of different mammalian species. Since immune system of neonates play an important role in neonatal growth and sexual maturation, it becomes a matter of quest that whether photic information perceived by mother can influence the immune status of neonates and finally the neonatal growth and sexual maturation. The present experiment conducted in a seasonally breeding rodent Indian palm squirrel *Funambulus pennanti* is first of its kind to check the possibility of maternal photic regulation of immune status in neonates and its ultimate effect on their growth and sexual maturation.

Materials and methods:

Pregnant female squirrels (Body weight: 120±5g) were collected in the month of march (reproductively active phase) from the vicinity of Varanasi (Lat. 25°18'N:Long. 83°1'E) The experiment was started after overnight acclimatization of pregnant females to laboratory condition. Fifteen acclimatized pregnant females were selected to have ≥ days of gestation period (total gestation period: ~45days) by feeling externally the size of embryo. The experimental females were divided into five groups of equal number (No.=3) exposing them to different photoperiodic schedules, i.e. Natural day length (NDL; 12L:12D), constant light (LL; 24L:0D), Constant dark (DD; 0L:24D), Long day length (LDL; 14L:10D) and short day length (SDL; 10L:14D). The delivered pups were reared under the respective photoperiodic conditions along with their mothers up to 60 days of their age (adulthood). The experiment was terminated by scarifying the pups by decapitation at night time (10.00 t0 11.00 PM). The blood was collected into the heparinized tubes and the plasma was stored at –20° C till hormonal assays.

Plasma level of Melatonin of the experimental pups was estimated following the Radioimmunoassay methos of Rollag and Niswender [4]. Total leucocyte counts (TLC) of fresh blood was taken in Neubaure's chamber under microscope. Subpopulation of lymphocytes was counted with Leishman's stain and Lymphocyte counts (LC) was calclulated as follow:

LC= TLC x Lymphocyte percentage/100

To study the blastogenic response the cell suspension of spllen from experimental pups was aliquoted into 2ml tubes and cultured with and without mitogen Con A. Blastogenic response of spenocytes to Con A was estimated following the method of Pauly and Sokal [5].

One-way Analysis of variance (ANOVA) followed by Neuman-Keul's multiple range tests were used in statistical evaluation of data.

Results:

The plasma level of melatonin in male and female pups decreased significantly under LL, DD and SDL conditions Fig. 1). The TLC (Fig. 2) and LC (Fig. 3) of male and female pups decreased significantly under SDL condition, while increased significantly under DD condition only. The blastogenic response of splenocytes to Con A (Fig. 4) of male and female pups increased significantly under SDL condition and decreased significantly under DD condition only.

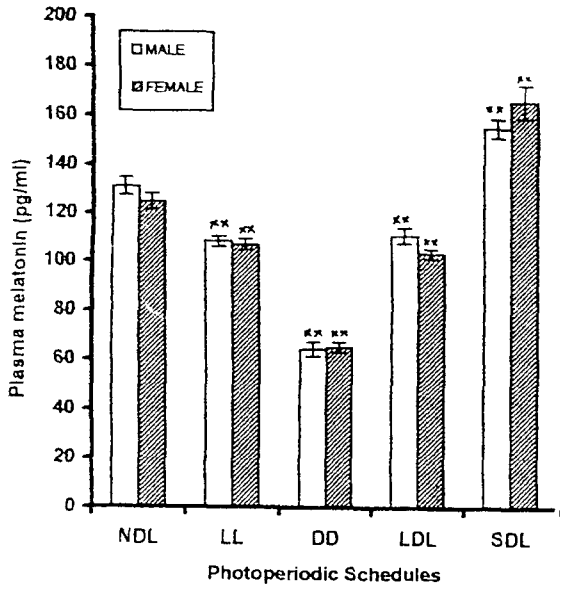

Fig. 1: Effect of the maternal photoperiodic exposures on neonatal plasma melatonin level (one way ANOVA: P for male and female pups <0.001; **: p<0.01)

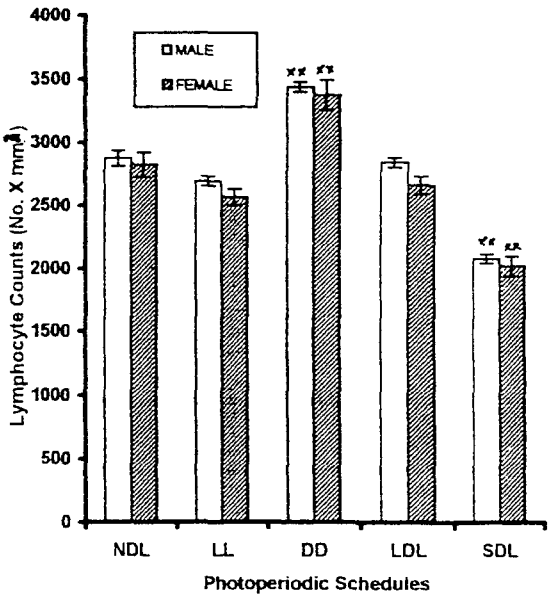

Fig. 3: Effect of the maternal photoperiodic exposures on neonatal lymphocyte counts [LC] (one way ANOVA: P for male and female pups <0.001; **: p<0.01)

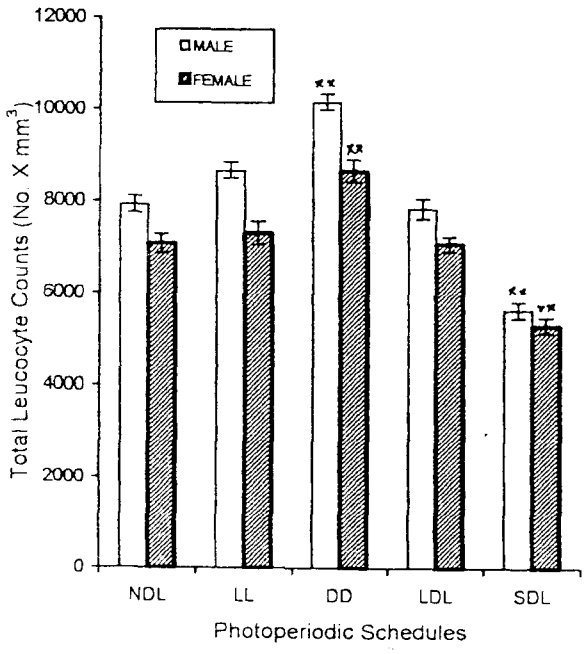

Fig. 2: Effect of the maternal photoperiodic exposures on neonatal total leucocytes count [TLC] (one way ANOVA: P for male and female pups <0.001; **: p<0.01)

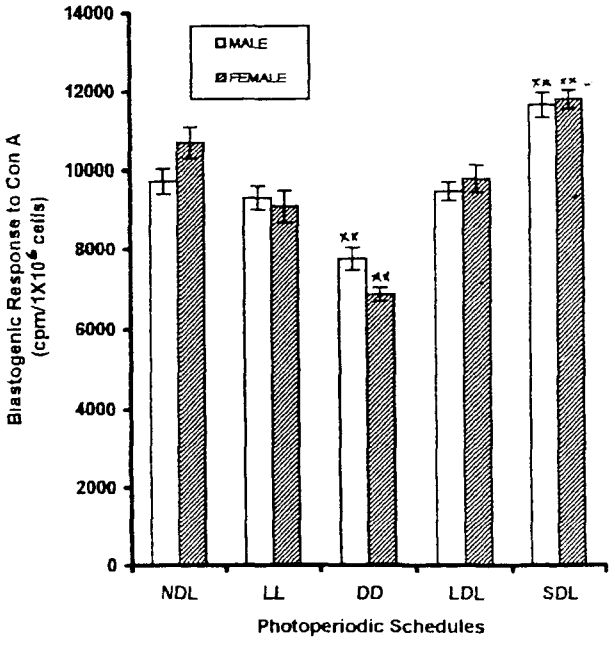

Fig. 4: Effect of the maternal photoperiodic exposures on neonatal blastogenic response of splenocytes to Con A (one way ANOVA: P for male and female pups <0.001; **: p<0.01)

Discussion:

Till date, the pineal gland and its major hormone melatonin has been proved to play an important role in transmitting the photoperiodic information to the animals through their retino-hypothalamic tract. Studies in several mammalian species suggested that melatonin could be transported from mother to her young ones either prenatally through placenta [2, 6] or postnatally via the milk [2,7]. Hence, depending upon the photoperiod to which the mother was exposed during gestation, the young ones respond it as ether stimulatory or inhibitory for their growth and developmental processes [2].

In the present experiment, the neonates of respective mothers exhibited similar variation in plasma melatonin level due to maternal transport of melatonin. Under SDL condition, the neonates exhibited a significant increase in pineal gland activity with an increased plasma Melatonin level, which not only reduced the neonatal growth and sexual maturation [3] but their immune status also, with an consequent decrease in TLC and LC and an increase in the blastogenic response (BGR) of splenocytes to Con A. Further extension of dark period i.e. constant darkness (DD0 has negatively regulated the pineal gland activity, hence a significant decrease in neonatal plasma Melatonin level was noted and the DD pups exhibited better growth and sexual maturation [3] along with high immune status with an increase in TLC and LC and a sdecrease in the blastogenic response of splenocytes to Con A.

Recent studies suggest an immuno-enhancing role of Melatonin [8]. Contrary to the reports available so far, present observation suggested an inhibitory effect of Melatonin on neonatal immune status with retarded growth and sexual maturation. This could be due to the fact that during neonatal life, young ones were fully dependent on the mother's milk and had a similar Melatonin level, which could not facilitate the immune system though inhibited neonatal growth and sexual maturation. In various mammalian species it has been observed that during winter, the immunity decreases [8]. However, the immune response of neonates to maternal Melatonin may vary with the advancement of age, especially when they respond to their own Melatonin.

Therefore, we may suggest that an optimal photoperiod is extremely important for the maintenance of proper immune status, neonatal growth and sexual maturation. Any disturbance to the maternal photoperiod may hamper the fitness of the neonates and their survival.

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