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**Regular Article**

# Role of Photic and Thermal Stimuli in Production of the Oestrus-inducing Pheromone in Field Mice

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**ABSTRACT**: Sixty adult males divided in six equal groups were exposed to different photoperiods for 21 days. Exposures included natural lights (ca 11 hr), long photoperiod (16L: 8D) and short photoperiod (8L: 16D). The first three groups received these exposures at room temperature (36-38$^0$C). Soiled bedding of the above males was introduced in the cages of unisexually housed noncyclic females and their potentiality to induce oestrus was assessed. It was observed that the bedding of all the males proved to be a stimulus inducing oestrus in majority of females during 7 days exposure. There was no significant difference in the number of female returning to oestrus following exposure to soiled beddings of different stimulus males. These results lead to conclude that environmental factors, especially light and temperature do not influence the production / release of the primer pheromone inducing oestrus in noncyclic Indian field mice.

**Key words:** Photoperiod, Temperature, Soil-bedding

## Introduction

Environmental factors have been reported to influence the reproduction and puberty in a variety of mammals (Bronson, 1985; Negus and Berger, 1972; Mateo *et al*., 1994; Marchlewska-Koj, 2003). Social stimuli do influence many aspects of reproductive performance including sexual maturation in rodents (Drickamer, 1981; Vandenbergh, 1988; Marchlewska-Koj, 2001, 2003a, b). Various social conditions which usually depress reproduction by evoking certain nonspecific emotional states are not less important (Ramaley, 1981). Individually housed female field mice exhibit regular oestrous cycle of about 7 days. Oestrus rhythm is disrupted and female attained anoestrus following unisexual grouping. An androgen-dependent urinary cue induces oestrus in anoestrous female wild mice (Pandey and Dominic, 1981). Occurrence of first vaginal oestrus in young prepuberal female wild mice is accelerated in presence of adult male while it is delayed in presence of adult females (Pandey, 1986).

The acceleration and delay of sexual maturation in female house mice are vulnerable to fluctuations in environmental factors (Drickamer, 1984). Adult females exposed to long photoperiod fail to delay puberty in juvenile female wild mice (Pandey and Pandey, 1989). Long photoperiod also abolishes mutual oestrus block in sparsely house females at raised temperature (unpublished observations). It is not known, how the environmental factors modulate the male-primed physiological events in female mice. The present effort was therefore aimed at evaluating the effect of photoperiod and temperature on production of the oestrus-inducing pheromone in Indian field mice.

## Material and Methods

Indian field mice (*Mus booduga* Gray) employed in this study were trapped from wild and maintained in the laboratory on a diet comprising soaked Bengal gram (*Cicer aretinum*), boiled rice and milk. Water was available *ad libitum*. Sixty eight female mice, weighing 12-15 g were first housed in galvanized steel isolation cages (34 X 18 X 14) for 21 days and their oestrous cyclicity was observed by the vaginal smear technique (Bronson, Dagg and Snell, 1968). Regularly cycling females (n=60) were then divide into six groups each with 10 and housed individually in colony cages , 30 x 30 x 30 cm for next 21 days. Together with the female unisexual grouping, ninety adult males weighing 12-15 g were divided in 6 equal groups and each group was housed in a colony cage. Males in group I, II and III were exposed to natural light: dark hrs (NLD), long photoperiod (16L: 8D) and short photoperiod (8L: 16D) respectively at room temperature (13-20$^0$C) for 21 days. Males in the remaining three groups (group IV, V and VI) were subjected to the above photoperiodic at 36- 38$^0$ C (Table 1).

Table 1: *Incidence of oestrus induction in unisexually housed females following their exposure to soiled bedding of males under different photoperiod and temperature*

| *Group* | Treatment | Total number of females | Number and percentage of females returning to oestrus |
|---|---|---|---|
| I | NLD, room temp | 10 | 9, 90% |
| II | 16L: 8D, room temp | 10 | 10, 100% |
| III | 8L: 16D, room temp | 10 | 8, 80% |
| IV | NLD,36-380C | 10 | 9, 90% |
| V | 16L:8D, 36-380C | 10 | 10, 100% |
| VI | 8L: 16D, 36-380C | 10 | 8, 80% |
| | | | X2 = 7.53<br>P = N.S. |

The males under long as well as short photoperiods were lit by florescent tubes at an intensity of about 400 lux. Direct sun light of January –February was available to males at NLD through east and west facing window of the laboratory. High temperature was maintained by a series of heat convectors. Cages were provided with aw dust bedding which was changed at weekly intervals. Soiled bedding collected from each group of males at the end of treatment was introduced in cages containing unisexually housed females for 7 days. The incidence of oestrus induction was indicated by the presence of cornified cells in vaginal smears. The data were analyzed by Chi-square test.

## Results

The majority of females (60/68) exhibited regular oestrous cycles during the period of isolation (day 1-21). The mean length of the cycle was 7.2 ± 0.24 days with an average number of 2.4 ± 0.28 oestrus per female. Oestrous rhythm was disrupted following unisexual treatment during the next 21 days (day 22-42) and most of them attained anoestrus. This was revealed by the presence of

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only leucocytes and / or mucus in the vaginal smears. The majority of anoestrus females in all the groups returned to oestrus when they were exposed to soil bedding of males for 7 days (day 43-49). Soiled beddings of males exposed to long or short photoperiod were as good in inducing oestrus in noncyclic females as the bedding of males housed under NLD at room temperature or at raised temperature (36-38$^0$ C). Oestrus was synchronized in most females and a peak return of oestrus was noted on day 4 in all the groups. The number of females returning to oestrus in various groups was not significantly different.

## Discussion

The results obtained in this study demonstrate that soiled beddings of all the males exposed to different day lengths and temperatures are equally potent in inducing oestrus in noncyclic females. Obviously, the photoperiod and temperature do not seem to contribute to the production / release of the oestrus inducing pheromone in Indian field mice. Environmental factors influence different aspects of mammalian reproduction in many ways (Bronson, 1985). To utilize the natural opportunity small and short-lived mammals should breed maximally whenever socially and energetically possible. These individuals must encounter the endeavours which act to detriment of reproduction. It is in view of energetic and nutritional variations that annual patterns of breeding have been evolved in mammals. Social cues maximize the probability of reproduction in a propitious environment by modulating the efficiency.

The social cues in wild mice which are of importance as follows; (i) the female pheromone causing the oestrus block in unisexually grouped females and (ii) the male urinary chemosignal inducing oestrus in noncyclic females. Increased day length eliminates oestrus block in sparsely housed females at raised temperature by altering the production of the pheromone and / or changing the sensitivity of grouped females. Termination of the oestrus block under long photoperiod and high temperature confers a reproductive advantage to the species as these environmental conditions are favorable for breeding (Pandey, 1986). The day length also influences pubertal onset in female white-tailed deer (Budde, 1983). Long photoperiod has been found to abolish the puberty-delaying capacity of female wild mice (Pandey and Pandey, 1989). Relevant to the present discussion is the seasonal change in the ability of puberty-influencing chemosignals in laboratory mice (Drickamer, 1984). Seasonal pattern of reproductive activity has also been reported in house mice (Pelikan, 1981).

The results reported here reveal that the production of the oestrus-inducing pheromone is independent of the day length and temperature. While visualizing these findings in natural population it is pertinent to mention that the cost of sustenance is very high under short day length and low temperature when food is usually in short supply (Perrigo and Bronson, 1983). For a typical male mammal it is advantageous to be reproductively ready throughout. But females usually wait and predict the favourable conditions of reproduction. Release of the oestrus-inducing pheromone is thus an attribute of the male's readiness for reproduction. Probably, natural selection has allowed males to release steadily the social cues even when the species is under energetic jeopardy. Seemingly, it is a strategy in which environmental factors modulate social influence of the females and not that of the males.

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