

# Increased Darkness Phase in Photoperiodic Cycle: Underlying Condition for Male Reproductive Failure

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**Abstract**—Studies have shown that variation in light-dark cycle influences secretion of many hormones. The aim of this study was to investigate the effects of alteration in photoperiodism cycle on serum level of LH, FSH and testosterone male rats. In this laboratory experimental study, 30 male Wistar rats were randomly divided to control group (exposed to 12h light - 12h dark), and groups exposed to 13, 15, 18 or 21h darkness/day of 6 rats in each group. After 8 weeks, blood samples were collected and following serum collection, the levels of LH, FSH and testosterone were measured. The data were statically analyzed using ANOVA. Serum LH and FSH levels significantly decreased in rats exposed to darkness for 18 and 21 h/day compared with control animals ( $P < 0.05$ ). Serum level of testosterone was significantly decreased in all groups exposed to darkness compared to control animals. The findings of this study suggest that prolonged periods of darkness results in decreased serum level of testosterone and leads to increased LH and FSH; according to which, darkness can be considered as a factor leading to sexual disorders.

**Keywords**— Darkness, LH, FSH, Testosterone, Rat.

## I. INTRODUCTION

A CIRCADIAN rhythm is any biological process that displays an endogenous; entrain able oscillation of about 24 hours. These rhythms are driven by a circadian clock, and rhythms have been widely observed in plants, animals, fungi, and cyanobacteria. The formal study of biological temporal rhythms, such as daily, tidal, weekly, seasonal, and annual rhythms, is called chronobiology. Although circadian rhythms are endogenous ("built-in", self-sustained), they are adjusted (entrained) to the local environment by external cues called zeitgebers, commonly the most important of which is daylight [1]. Photoperiodism is the physiological reaction of organisms to the length of day or night. It occurs in plants and animals. Photoperiodism can also be defined as the developmental responses of plants to the relative lengths of the light and dark periods. Here it should be emphasized that photoperiodic effects relate directly to the timing of both the light and dark periods [2]. Human reproductive failure, or the

ability to conceive or to carry a pregnancy to term, is a surprising frequent event. Categories of reproductive failure are defined as follows. Infertility is the failure to conceive after frequent unprotected intercourse [3]. The crucial role of light in the regulation of reproductive cycles in animals has been the subject of experimental study for over the years [2].

Light exerts its effect on the reproductive condition of male coturnix by controlling gonadotropin secretion, which in turn controls gonadal growth and androgen secretion. Androgen then stimulates the growth and secretion of the cloacal gland, acts on the neural tissues to stimulate mating behavior, and feeds back onto the hypothalamo-hyperphysical system to regulate gonadotropin secretion [2].

It has been shown previously [4], [5], that the rate of sexual maturation of juvenile quail is approximately proportional to the number of continuous hours of light each day under which they are reared. The reproductive condition of male coturnix was depressed by shifting them from long to short photoperiods. Exposure of the males to long photoperiods maintained their breeding condition, or returned the males to breeding condition if it had been depressed by short photoperiods [2]. However, apart from work on a diurnal variation in gonadotropin secretion, little other experimental evidence is available on the response of adult male coturnix to changes in photoperiod [4] – [10]. Although the duration of light each day is important in regulating the reproductive condition of male coturnix, other factors are also involved, as there is no simple correspondence between number of hours of daily light and any measure of reproductive condition [11]-[12]. The aim of this study was to assess the effects of alteration in photoperiodism cycle on serum level of LH, FSH and testosterone male rats.

## II. MATERIAL AND METHODS

### A. Animals

Adult Wistar rats weighting  $200 \pm 30$ g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran). The temperature was at  $23 \pm 2$  °C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow. Care was taken to examine the animals for general pathological symptoms. Food was withheld for 12-14h before death.

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### B. Protocol of Study

In this laboratory experimental study, 30 male Wistar rats were randomly divided to control group (exposed to 12h light - 12h dark), and groups exposed to 13, 15, 18 or 21h darkness/day of 6 rats in each group. After 8 weeks, blood samples were collected and following serum collection, the levels of LH, FSH and testosterone were measured using radioimmunoassay method. All animal experiments were carried out in accordance with the guidelines of Institutional Animals Ethics Committee.

### C. Statistical Analysis

All values are presented as mean  $\pm$  S.E.M. Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Significance was measured using Fisher's least significant for the exact P values and significant differences are noted in the results. Differences with  $P < 0.05$  were considered significant

### III. RESULTS

Table I shows serum levels of LH, FSH and testosterone in male rats.

TABLE I  
SERUM CONCENTRATIONS OF LH, FSH AND TESTOSTERONE IN CONTROL AND RATS EXPOSED TO 13, 15, 18 OR 21H DARKNESS/DAY.

Groups Hormone	Control	13h dark/day	15 dark/day	18h dark/day	21 dark/day
LH ( $\mu$ U/ml)	0.22 $\pm$ 0.05	0.34 $\pm$ 0.06 NS	0.24 $\pm$ 0.06 NS	0.44 $\pm$ 0.04 <0.05	0.64 $\pm$ 0.07 <0.001
FSH ( $\mu$ U/ml)	29.22 $\pm$ 3.7	34.82 $\pm$ 3.27 NS	25.40 $\pm$ 1.50 NS	47.89 $\pm$ 5.69 <0.05	48.54 $\pm$ 7.00 <0.05
Testosterone ng/ml	12.94 $\pm$ 3.1,28	6.15 $\pm$ 1.54 <0.001	7.4 $\pm$ 1.47 <0.01	1.82 $\pm$ 0.55 <0.001	3.14 $\pm$ 0.52 <0.001

The data are indicated as mean  $\pm$  SEM . P values are expressed in comparison with control group. N.S. represents non significant difference.

The results of the present study show that serum LH and FSH levels significantly decreased in rats exposed to darkness for 18 and 21 h/day compared with control animals ( $P < 0.05$ ). Serum level of testosterone was significantly decreased in all groups exposed to darkness compared to control animals.

### IV. DISCUSSION

Our study indicated that serum LH and FSH levels did not significantly change in rats exposed to darkness for 13-15hours/day compared with control rats but significantly increased in groups exposed for 18-21hours/day compared to control animals and that Serum level of testosterone was significantly decreased in all groups exposed to darkness compared to control animals. In line with this findings, there are other report showing the effects of darkness on testosterone level [2], [4]-[5]. Although there are reports showing that daily light do influence reproductive conditions of male hormones

[2], several findings indicate that factor other than light can affect on sex hormones [12].

### V. CONCLUSION

The findings of this study suggest that prolonged periods of darkness results in decreased serum level of testosterone and leads to increased LH and FSH; according to which, darkness can be considered as a factor leading to sexual disorders.

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