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Effect of photoperiod on the adrenal activities of male rose ringed parakeet, *Psittacala krameri*

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Abstract: *Adult male rose ringed parakeets were exposed to very long photoperiod (22 hr L: 2 hr D) and very short photoperiod (2 hr L: 22 hr D) daily for 60 days during different phases of the annual testicular cycle. Adrenal activities of the experimental birds were compared with that of parallel held natural photoperiodic birds. Marked atrophy of adrenocortical cells was noted in the glands of long photoperiod (22 hr L:2 hr D) during different phases i.e. post-breeding, quiescent and pre-breeding phases of annual gonadal cycle. The atrophied cells were not uniformly distributed in different groups of long photoperiod responsive birds. During pre-breeding, post-breeding and quiescent phases marked atrophy of the adrenocortical cells were restricted to the sub capsular zone of the gland. The cytometric and karyometric studies also revealed significant decrease in the cortical cord width and diameter of nuclei in the cortical cells in either subcapsular zone in the gland of long photoperiodic birds considered for treatment during pre-breeding, post-breeding and quiescent phase or in both the sub capsular zone and the inner zone. The cytometric and karyometric values did not show any change from control birds.*

Key words: *Birds, Photoperiod, Gonadal activities, Microtomy, Adrenocortical tissues, Seasonal changes*
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Introduction

A number of factors have been shown to influence the histology of the avian adrenal glands and a wide variety of functions *e.g.*, a relationship between reproduction and corticoid activity are connected with corticoid hormones. Seasonal changes in the adrenal gland in relation to the gonadal activities of the several wild bird species have been reported by Silverin, 1979; Peczely, 1985; Maitra, 1987, 1989. However a possible inter relationship between the annual changes in adrenal cortex and surrounding environmental factor could not be ascertained. Several authors emphasized the importance of corticosterone in the mediation of photoperiod induced changes of the gonads on the basis of experimental data (Wilson and Follett, 1975; Johnson and Van Tienhoven, 1981; Bhardwaj and Anushi, 2006). Though precise mechanism for the periodic activation of the steroidognic part of adrenal gland is not clearly known. Many workers support the conjecture that, endocrinemoiety is probably involved in the photoperiodic regulation of gonadal factions in birds (Assenmacher and Jallageas, 1980; Deviche, 1983; Peczely, 1985; Dawson *et al.,* 2001; Yashimura *et al.*, 2003;Yamamura *et al.*, 2004; Sharp, 2005; Yasuo *et al.*, 2005). No systematic study on these lines has yet been made to examine the behavior of adrenal gland under altered photoperiodic regimene during different phases of the annual testicular cycle in *Psittacula krameri*

Materials and Methods

Adult male rose ringed parakeets, *Psittacola krameri* were collected from their natural habitat in the adjacent areas of Ghaziabad. The birds were acclimatized for about a week in an out door aviary under natural photoperiods. The food and water was provided *ad-libitum* during acclimatization. The experiments were conducted during 4 different phases of the annual testicular cycle of the experimental bird. In each phase, freshly collected birds were divided into 3 different groups. Each group containing 6 birds (housed in cages measuring 90 x 60 x 30 cm) were separately held under natural photoperiod (12L and 12L hr), short photoperiod (2 hr L: 22 hr D/day) and long photoperiod (22 hr L: 2 hr D). Except for the natural photoperiodic test bird, *Psittacala kramiri* artificial light was provided with white fluorescent lamps (intensity of light varied between 250-300 lux at cage level in the two test groups.

After exposure, body weight of birds was taken and quick dissection was performed to remove both the adrenal glands and weighed on electric digital balance sensitive to 0.01 mg. The adrenal gland was fixed in aqueous Bouin's fluid. The dehydration was completed in ascending series of alcohol and routine microtomy was done to obtain 5-7μm thick paraffin sections and stained with haematoxylin. Diameters of at least 30 cortical cords and about 100 round nuclei from each of the sub capsular and inner zones were measured from the stained sections with the help of calibrated scale of an eyepiece ocular for obtaining mean values for each individual.

All the results were statistically analysed and depicted as mean ± SE.

Results and Discussion

The adrenal gland of the rose ringed parakeet is small yellowish, elongated and streak like structure attached ventrally to the anterior lobe of kidney. The gland is made up of upper cortex and inner medulla. In embryonic stage both cortex and medulla originate from mesoderm and ectoderm or neural crest respectively.

The mean values of body weight and paired adrenal gland in different test groups (natural photoperiod, short photoperiod and long photoperiod of 12 hr L:12 hr D, 2 hr L:22 hr D and 22 hr L:2 hr

Table - 1: Adrenocortical responses to different photoperiods during quiescent and post breeding phase of the annual testicular cycle of rose ringed parakeet (Values are mean ±SE)

Reproductive phases	Photoperiodic groups	Body weight (g)	Relative adrenal weight (mg)	Cortical cord width (μm)		Nuclear diameter (μm)	
				SCZ	IZ	SCZ	IZ
Post-breeding phase	Natural photoperiod (NP)	116.6±1.1	19.3±5.1	37.02±.03	37.33±.02	4.98±.03	5.65±.02
	Long photoperiod (LP)	116.7±1.5	18.2±4.2	32.85±.03	33.09±.06	3.98±.01	5.10±. 01
	Short photoperiod (SP)	112.5±1.7	18.3±4.7	37.52±.15	35.92±.15	5.00±.01	5.70±.05
Quiescent phase	Natural photoperiod (NP)	111.6±.6	15.1±3.6	38.68±.04	38.65±.02	5.69±.01	5.81±.01
	Long photoperiod (LP)	113.5±.09	16.2±2.5	29.29±.13	32.64±.01	4.42±.01	5.96±.02
	Short photo period (SP)	114.15±2.0	16.8±3.2	36.64±.02	37.08±.01	5.59±.05	5.00±.01

SCZ = Sub capsular zone
IZ = Inner zone

Table - 2: Adrenocortical responses to different photoperiods during pre-breeding and breeding phase of the annual testicular cycle of rose ringed parakeet (Values are mean ± SE)

Reproductive phases	Photoperiodic groups	Body weight (g)	Relative adrenal weight (mg)	Cortical cord width (μm)		Nuclear diameter (μm)	
				SCZ	IZ	SCZ	IZ
Pre-breeding	Natural photoperiod (N P)	130.3±1.9	14.9 ±2.4	35.00±.03	32.70±.04	4.77±.02	5.19 ±.01
	Long photoperiod (L P)	125.2±2.0	13.7±2.1	29.75±.05	30.23±.03	4.50±.04	5.13±.01
	Short photoperiod (S P)	127.4±1.9	19.4±1.0	32.59±.01	30.81±.03	4.67±.03	4.42±.02
Breeding	Natural photoperiod (N P)	123.1±2.6	20.2±1.3	39.96±.02	38.76±.02	4.74±.03	5.00±.01
	Long photoperiod (L P)	117.4±1.6	21.7± .90	40.25±.03	41.15±.02	4.62±.02	5.09±.01
	Short photo period (S P)	115.7±1.9	18.1± 2.0	41.10±.01	40.09±.02	4.68±.01	5.04±.01

SCZ = Sub capsular zone
IZ = Inner zone

D respectively) of birds, irrespective of the experience of photo periodic schedules and reproductive phase of treatment, did not show any changes from the respective natural photoperiodic bird (Table 1, 2, Fig. 1, 3)

The adrenal gland consists of anastomosing strands of cortical cell, patches of medullary cells and blood capillaries. The columnar cortical cells are arranged in double row pattern. The randomly distributed medullary cells occur in the form of clumps or patches and are quite prominent which are polyhedral having large nuclei and arranged irregularly. The ratio of cortical to medullary tissues has been found to be relatively uniform through out the gland. In general, differences have been observed in the histology (corticalcord width and nuclear diameter) of the adrenal gland in the different group of experimental birds (Table 1, 2). It is worth mentioning here that histomorphologically this endocrine tissue (Fig. 1, 4) can be differenciated into outer sub capsular zone and inner zone, both of which undergoes precise seasonal changes parallel to the testicular cycle of rose ringed parakeet. In each of these stages, various hormones prepares the bird for breeding and other seasonal activities. As birds moves into breeding condition, they gain body weight and maintain better postures for appeal in the courtship rituals. Weight gain again occurs towards the end of quiescent phase (Table 1, 2)

In the present work, marked atrophy of adrenocortical cells was noted in the gland of long photoperiod (22 hr L: 2 hr D), parakeets, during different phases *i.e.* post-breeding, quiescent and pre-breeding phase of the annual gonadal cycle. But atrophied cells were not uniformly distributed in different groups of long photoperiod

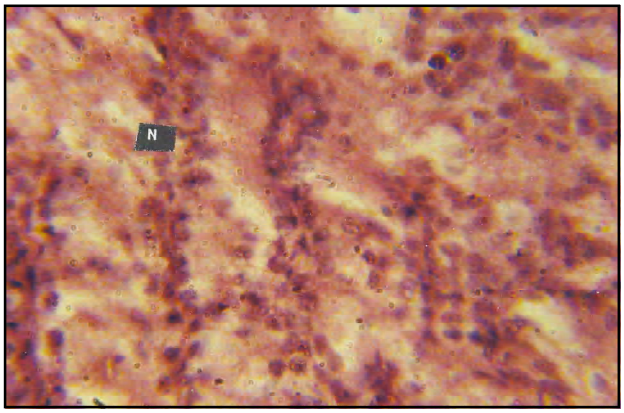

Fig. 1: Adrenal cortex showing healthy cells in both sub capsular and inner zone, in the birds captured during pre-breeding phase and held under natural photoperiod

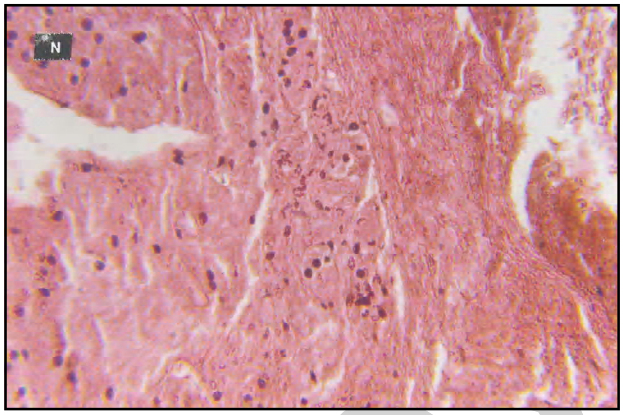

Fig. 2: Marked atrophy of the adrenocortical cells restricted to the SCZ. In the birds exposed during pre-breeding phase under long photoperiod

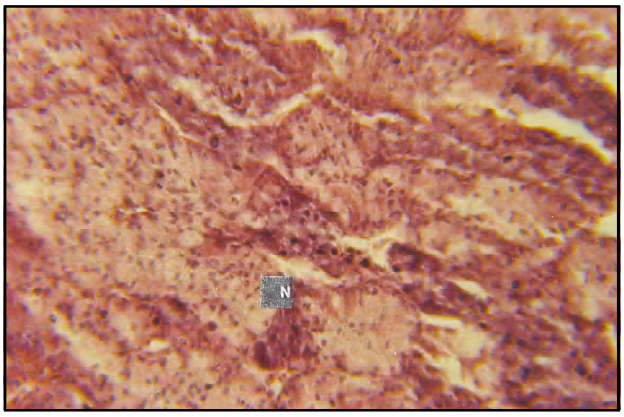

Fig. 3: Adrenocortical cells of the adernal gland, the birds collected during breeding phase and held under natural photoperiod

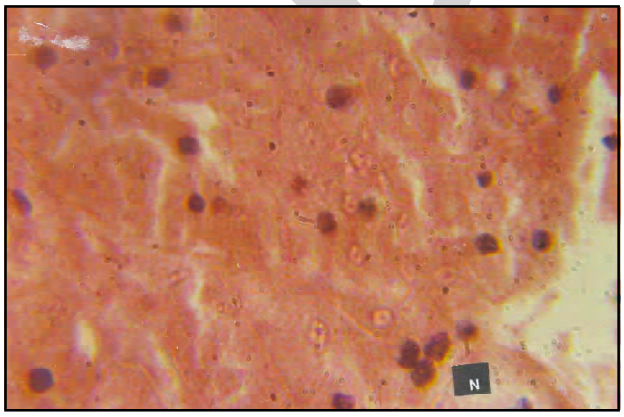

Fig. 4: Pycnotic nuclei in the atrophied cells of both SCZ and IZ, the birds captured during quiescent phase and exposed to long photoperiod

responsive birds. During pre-breeding, post-breeding and quiescent phase marked atrophy of the adrenocortical cells were restricted to the sub capsular zone of the gland (Fig. 2), while at the begining of quiescent and breeding phase abundance of pycnotic nuclei in the degenerated cells were seen in both the sub capsular zone and inner zone of the adrenal cortex of long photoperiodic birds (Fig. 4). Cytometric and karyometric studies also revealed significant decrease in the cortical cord width and diameter of nuclei in the cortical cells in either subcapsular zone in the gland of long photoperiodic birds considered for treatment during pre-breeding, post-breeding and quiescent phase or in both the sub capsular zone and the inner zone in similar treated birds in different phase of annual reproductive cycle (Table 1, 2). The cytometric and karyometric values of adrenals of the studied birds under long photoperiod (22 hr L: 2 hr D) during breeding phase did not show any change from control birds (Table 2). In qualitative and quantitative aspects, adrenal cortex of short photoperiod (2 hr L: 22 hr D) birds, irrespective of the sexual phase under consideration, appeared essentially similar to those in the respective natural photoperiodic birds.

In the present investigation, influence of altered photoperiods on the tissues of adrenal glands in rose ringed parakeet was noticed in the body weight, adrenal weight, cortical cord width and nuclear diameter in cortical cells. It is generally agreed that secretory activity of the adrenal cortex is directly related to the size of the nuclei and that of respective cells (Gorman and Milne, 1971; Silverin, 1979). Thus the, results of the present investigation favour the conjecture that the short photoperiod (2 hr/day) does not influence the secretory activity of adrenal in any phase of annual testicular cycle where as it varies in relation to the annual reproductive phase of rose ringed parakeet at increased photoperiod (22 hr/day). (i) during breeding phase, activity of the adrenal gland of remains unaffected (ii) during pre-breeding phase adrenal activities are decreased only in the sub capsular zone and (iii) during post-breeding and quiescent phase adrenal activities are reduced in both sub capsular and inner zone of the gland.

The parallel adrenal and gonadal relationship is reported in many species of birds, *e.g.* house finch, *Carpodacus mexicanus* (Hamner,1966), common myna, *Acridotheves tristis* (Chaturvedi and Thapliyal, 1979) and brahminy myna, *Sturnus pagodarum* (Bhardwaj and Kumar, 2004). In verse relationship has also been reported in few species of birds, like white crowned sparrow, *Zonotrichia lencophrys gambelli* (Harris and Turek ,1982). Many workers (Wilson and Follett, 1975; Johnson and Van Tienhoven, 1981; Peczely, 1985) supports that adrenocortical factors are

probably involved in the mediation of photoperiodic influences on the regulation of avian reproduction. Avian breeding season tend to be of shorter duration and more asymmetric with respect to changes in photoperiod.

Present study concludes that the long photoperiod induces adrenocortical regression, in all phases (pre-breeding, quiescent and post-breeding) except the breeding phase of the annual cycle.

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