EFFECT OF EXOGENOUS 17β-ESTRADIOL ON GONADAL PHOTOSTIMULATION IN HOUSE SPARROW, *PASSER DOMESTICUS* (LINN.)

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ABSTRACT

Intramuscular injection of 17β-estradiol inhibited photoperiod induction of gonads in female subtropical house sparrow (*Passer domesticus*), with no effect on body weight. This suggests that exogenous 17β-estradiol has an antigonadal effect in this species. The effect is due to the negative feedback mechanism of the hormone at the hypothalamo–hypophyseal axis.

INTRODUCTION

It is well established that sex steroids play an important role in the regulation of reproductive and associated functions in birds. Different gonadal responses to exogenous androgen and estrogen have been reported, which have antigonadal, progonadal, or no effect in several avian species[1–8]. The effect of exogenous gonadal steroids has been less extensively studied in subtropical photoperiodic bird species, particularly in females. Both progonadal and antigonadal effects of testosterone have been reported in temperate zone species of the house sparrow[5]. In view of the paucity of a unifying concept, we investigated the effect of exogenous 17β-estradiol on the regulation of ovarian, oviducal and body weight responses in the house sparrow, a subtropical, non-migratory passerine bird.

MATERIALS AND METHODS

Adult female house sparrows were captured locally and acclimatized for 15 days to laboratory conditions. They were then exposed to an 8L:16D photoperiod regime for eight weeks to make them photosensitive. At this time all the birds had regressed ovaries (ovarian weight 4–6 mg) and normal body weight (18–21 g). In the house sparrow, long days are gonadostimulatory and short days (light for less than 11 h) are non-stimulatory[9]. Food and water were given *ad libitum*. The bird enclosure was illuminated by 20-watt fluorescent tubes, which provided a light intensity of about 400 lux at perch level. At each laparotomy, ovarian weight was assessed by comparing the size of the ovary *in situ* with a standard set of ovaries of known weight. The error by this method was less than ±20%. Data were analysed statistically by the Student's *t* test[10].

Experiments were performed, viz. with photosensitive birds and with photostimulated birds.

Photosensitive birds (exposed to short-day regime) were divided into four groups ($n=15$ each) and exposed to long-day photoperiod (15L:9D) for 50 days. Their initial ovarian condition *in situ* (by laparotomy) and body weight were recorded. Four birds were weighed and then sacrificed; their ovaries and oviducts were taken out, freed of extra tissues, and weighed after the luminal fluid was squeezed out gently on a folded filter paper. Seven intramuscular injections of 17β-estradiol (Sigma Chemical Co., USA) were given at every two days from the day of commencement of long-day photocycle. Three doses of hormone in 0.1 ml of propyleneglycol were administered. One group received a high dose (100 μg), another received 25 μg and the third group received a low dose of 5 μg. The fourth (control) group was given only 0.1 ml propyleneglycol. Injections were given between 10.00 and 10.30 a.m. Ovarian, oviducal and body weights of three birds from each group were recorded on days 15, 30 and 50.

In the other experiment birds kept under long photoperiod regime for 40 days were used. The photostimulated birds were divided into four groups ($n=4$–6) and exposed to the same long photoperiod regime (15L:9D) for 50 days. The birds were treated as described above for photosensitive birds, and ovarian weights were recorded on days 15, 30 and 50.

RESULTS

The results of the experiment with photosensitive birds are given in table 1.

On day 15 no differences were evident between the groups. On day 30 ovarian weight of birds given 25 and 100 μg estradiol were significantly reduced. On

Table 1 *Effect of 17β-estradiol on ovarian, oviducal and body weight responses in photosensitive house sparrow under long photoperiod (15L:9D) regime*

Parameter	Day of observation	Dose: None (control)	5 μg	25 μg	100 μg
Ovarian weight (mg)	15	6.50 ± 0.28	6.10 ± 0.22	6.30 ± 0.42	5.80 ± 0.20
	30	9.70 ± 0.16	9.40 ± 0.30	8.00 ± 0.28*	6.43 ± 0.28*
	50	23.10 ± 1.22	20.10 ± 0.44**	13.00 ± 0.36*	11.00 ± 0.33*
Oviducal weight (mg)	15	4.10 ± 0.20	117.43 ± 1.90*	136.66 ± 2.60*	192.46 ± 4.05*
	30	5.70 ± 0.44	13.83 ± 0.92*	38.56 ± 0 92*	49.93 ± 5.23*
	50	15.00 ± 0.00	10.33 ± 0.60*	10.83 ± 0.60*	11.80 ± 0.68*
Body weight (g)	15	20.33 ± 0.60	19.40 ± 0.45	19.20 ± 0.46	19.43 ± 0.83
	30	20.50 ± 0.57	19.63 ± 0.56	19.33 ± 0.44	19.13 ± 0 46
	50	19.93 ± 0.07	19.33 ± 0.35	19.53 ± 0.46	19.00 ± 0.26

All values are mean ± SEM.
Significance of difference (vs respective control): *$P < 0.001$, **$P < 0.05$.

day 50 photostimulation of ovarian weight was evident in all the four groups, but estradiol produced a dose-dependent inhibition of photostimulation, and the inhibition was significant at all three doses. The different groups did not differ in body weight. At the beginning of exposure to long photoperiod regime, oviducal weight was minimum (2 to 4 mg). On day 15 oviducal weight was very high in all three hormone-treated groups (table 1) but not in control birds. Moreover, there was a dose-dependent difference between the hormone-treated groups. Oviducal weight of the hormone-treated birds had decreased considerably by day 30, but were still higher than that of control birds. On day 50, however, control birds had higher oviducal weight than hormone-treated birds.

The results of the experiment with photostimulated birds are given in table 2. The dose-dependent inhibitory effect of estradiol on photostimulation of ovarian weight is again evident.

DISCUSSION

The results clearly indicate that 17β-estradiol treatment inhibits ovarian response in both photosensitive and photostimulated birds under stimulatory long photoperiod regime (15L:9D). It is suggested that the long-day-induced ovarian growth is directly under the control of hypophyseal gonadotrophins and it seems quite apparent that the exogenous estradiol prevents rise in the levels of both FSH and LH, thereby inhibiting ovarian growth. This effect of 17β-estradiol in female house sparrow is through a short-loop negative feedback mechanism. Similar reports are available for other birds[1, 3, 8, 11]. Turek *et al.*[5] reported that 500 μg testosterone per day (released from testosterone-filled silastic capsules administered into the peritoneal cavity) stimulated testicular growth in house sparrows exposed to a non-stimulatory (8L:16D) photoperiod. Further, a dose-dependent, differential effect of testosterone has

Table 2 *Effect of 17β-estradiol on long-day-induced ovarian weight responses in photostimulated house sparrow*

Parameter	Day of observation	Dose: None (control)	5 μg	25 μg	100 μg
Ovarian weight (mg)	0	16 00 ± 00	15.00 ± 00	14.25 ± 0.30	15.50 ± 0 28
	15	18 80 ± 0.58	11.50 ± 0.28*	11.00 ± 0.40*	9.00 ± 0.40*
	30	22 20 ± 0.50	13.50 ± 0.28*	13.25 ± 0.47*	10.25 ± 0.47*
	50	25.20 ± 0.37	19.50 ± 0.95*	15.50 ± 0.64*	13.00 ± 0.40*

All values are mean ± SEM
*Significant difference (vs respective control), $P < 0.001$.

been reported in the male house sparrow by the same authors. In Lalmunia, it is reported that 0.5 μg and 5.0 μg testosterone suppressed testis growth during the progressive phase but produced no effect in the late progressive and/or breeding phase[7]. However, 100 μg testosterone inhibited fully developed gonads of male Lalmunia and red-headed bunting[7]. Lower doses also suppressed gonadal growth in the house sparrow[5].

An interaction between length of photoperiod and gonadal steroids during the annual reproductive cycle has also been reported to modulate gonadotrophin secretion[11-15]. A striking difference in the rate of hypophyseal output of gonadotrophin (especially LH) between male and female birds has been observed during photostimulation[15,16]. The reason for such a difference between the sexes has been attributed mainly due to the negative feedback action[3,15].

Unlike the observations with female subtropical house sparrow, a dose-dependent, differential effect of testosterone has been reported on the testes of sexually mature house sparrow[5]. The present results are, in general, contrary to those of previous investigations, in which the testosterone could exert stimulatory or inhibitory effect on avian testes[17,18].

The oviducal hypertrophy seen in hormone-treated birds is possibly due to the influence of exogenous 17β-estradiol. But control group oviducal growth was evident when the ovaries showed growth under normal photostimulation. Increase in oviducal weight in the control group clearly indicates the high endogenous level of estradiol in photostimulated birds. Similar findings have been reported in other birds[19,20]. In the hormone-injected groups, ovarian photostimulation was brought about as the effect of exogenous hormone was removed, and thus the oviduct remained under the influence of high endogenous levels of estradiol.

The results also indicate that 17β-estradiol does not play a role in body weight regulation in the house sparrow. This is similar to results for the non-migratory resident species, the Lalmunia[7].

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