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Role of Testosterone Hormone on Body Weight and Testes in Adult Male Brahminy Myna under Short Day Length

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Abstract
This experiment was carried out on adult male brahminy myna. Birds were procured from the wild in the last week of January 2005 and acclimatized in the out door aviary. Four groups (1-4) of birds were subjected to short day length (8L:16D), and received olive oil (0.1 ml), 25 µg TP, 50 µg TP and 75 µg TP per bird on alternate day respectively. Body mass and testicular volumes were collected at the beginning and at end of the experiment. The observation of this study was that the injections of testosterone propionate at 75 µg TP per bird can induce testicular growth in short day length or non stimulatory photoperiod.
Key words: brahminy myna, testis, photoperiod, testosterone propionate

Introduction

Previous studies have described male tropical birds as having low plasma concentrations of testosterone, involving low-amplitude cycles with possible slight elevations during times of breeding (Moore *et al.*, 2004). It is thought that these low concentrations are a way of avoiding the potential detrimental effects of elevated concentrations of testosterone (Wingfield *et al.*, 2001). In males of many birds, territorial behaviors, such as song and aggressive displays, are regulated by the hormone, testosterone (Hirschenhauser *et al.*, 2003).

In general, circulating plasma levels of testosterone (T) increase in early spring from baseline levels of 0.1 – 0.2 ng/ml to about 2 – 10 ng/ml and then remain elevated throughout most of the reproductive period (Wingfield and Farner, 1993). There appear two pathways by which T can influence behavior: (i) by binding to androgen receptors (Labrie, 1993), and (ii) by being converted in the brain into 17-b estradiol (E2) by the enzyme aromatase (Wade *et al.*, 1994). The photoperiodic condition and social context may modulate the effects of steroids on song control regions (SCR) and singing behavior in adult male songbirds in the fall (Strand et al., 2008). In male song birds suppression of sickness behavior could occur when testosterone (T) is elevated to socially-modulated levels (Ashley et al., 2009).

Role of gonadal steroids in the regulation of gonadal cycles has been studied in several Indian birds (Kumar *et al*., 2009; Kumar and Kumar, 1992; Neelam, 2005; Sharma *et al.*, 2007). Studies on these species have revealed that, depending on the species, on the phase of the gonadal cycles, and on the dose administered, testosterone may stimulate, inhibit or produce no effect on gonadal cycles of Indian birds. Saxena (1964) studied the role of testosterone in testicular cycle of the Indian weaver bird. Effects of testosterone on testicular cycle were studied in detail in the Indian weaver bird (Thapliyal *et al*., 1983). In long-term experiments, high doses of testosterone were found to be gonadostimulatory, whereas low doses of the hormone induced either stimulation or inhibition of testicular activity, depending on the phase of the testicular cycle when the treatment was started. Gonadal hormones have also been reported to be involved in the regulation of photoperiodic responses and photorefractoriness in more Indian species (Tewary *et al*., 1985). In birds with an inverse thyroid-gonad relationship, testicular hormones are supposed to protect the hypothalamo-hypophyseal-gonadal axis from the negative feedback of thyroid hormones (Lal and Thapliyal, 1985a). It is, thus, reasonable of gonadal hormones are actively involved in the regulation of gonadal cycles in Indian birds. In male vertebrates, the hormone testosterone increases in the circulation during the breeding season (reviewed in Nelson, 2000). Testosterone promotes the development of many male secondary sexual characteristic (Emerson, 2000). The gonadotrophin-inhibitory hormone (GnIH) provides novel directions to investigate neuropeptide regulation of reproduction (Tsutsui *et al.*, 2009). The gonadotrophin-inhibitory hormone (GnIH) and its related peptides are important modulators of reproductive function at the level of the GnRH neurone, the gonadotroph and the gonads (Bentley et al., 2009). Therefore, in this study, we investigated the role of testosterone propionate (male hormone) on body weight and testicular response under short day length in adult brahminy myna.

Material and methods

Experiment was performed in the photoperiodic chambers of the laboratory but a group of the experiment was done in natural day length (NDL) room. During artificial photostimulation in different photoperiods of various experimental series, groups of birds were held in light – tight boxes lit by compact fluorescent tubes (CFL, Phillips) of 14 watt of an intensity of ~ 600 lux at perch level. Automatic time switches (Muller clock) controlled the periods of light and dark. In caged condition, birds were kept in small groups of (size – 45 x 30 x 30 cm) were placed in the photoperiodic box (size – 75 x 70 x 60 cm) for photoperiodic experiments.

All birds were individually weighed on a portable top pan balance to the nearest 0.1g to record the changes in body mass. For this, the birds were individually wrapped in small cotton bag and weighed before being laparotomized. Testicular volume was calculated from the Bissonnette's formula (Bissonnette, 1931; 1937) i.e. $V = 4/3\pi ab^2$, where V is the volume, a is half of the long axis and b is the radius of the testis at its widest point. Results were analysed using paired student t test. Significance was always taken at $P < 0.05$. Data from these measurements were collected at the beginning and at end of the experiment.

Experiment

This experiment was performed on photosensitive, adult male brahminy myna procured locally at 29°N. This experiment began on 04 January 2005. Four groups (1-4) of birds were subjected to non stimulatory photoperiod (8L:16D), and received olive oil (0.1 ml), 25 µg TP, 50 µg TP and 75 µg TP per bird on alternate day respectively. In total, fifteen injection were made. Body weight and testicular response were studied in this experiment. Observations were made at the beginning and end of the 30 day of the experiment.

Result

The results are shown in figure 1. The mean body mass was slightly increased after 30 days among all the four groups, exposed to 8L:16D (Paired Student t test: olive oil (control group), P=0.0387; 25µg TP, P=0.0192; 50µg TP, P=0.0210; and 75µg TP, P=0.0125) (fig 1a).

The testis volume of 50µg TP group was slightly stimulated but the testis volume of 75µg TP group was significantly stimulated upto day 30. There was a significant difference in testis volume of three groups of 8L:16D (Paired Student t test: olive oil (control group), P=0.4614; 25µg TP, P=0.2025; 50µg TP, P=0.0109; and 75µg TP, P=0.0001) (fig 1b).

Discussion

Testosterone injections at high doses can induce testicular growth in photorefractory birds with regressed testis, and continuous administration of androgens can support as well as stimulate testicular growth in photosensitive house sparrows (Passer domesticus) exposed to short days (Desjardins and Turek, 1977). During the breeding season, a significant fall both in the testis weight and the diameter of the seminiferous tubules was observed. In the post-breeding phase, testes of all control birds were very small and in the state of regression. Testosterone treatment during the period when the gonads were inactive did not affect the testis weight. It is suggested that the differential effect of exogenous TP on the testes are due to its dose–dependent action (Turek, et al., 1976). In Western Scrub-Jays (Aphelocoma californica) birds with unpredictable food had slightly lower testosterone levels relative to controls, but there was no effect on estradiol or luteinizing hormone (Bridge et al., 2009).

Effect of TP has also been investigated in the migratory red headed bunting, Emberiza bruniceps (Kumar and Kumar, 1990). TP declines food intake but dose not potentially affect the gain in fat and body mass. This suggested that photoperiodic effects on fattening and weight gain in Emberiza bruniceps were not exerted through hyperphagia. The authors argue that, probably, the hormones other than gonadal steroids (viz. prolactin, adrenal steroids) are involved in the control of fattening and weight gain in buntings.

There have been different accounts of the effects on TP on reproductively mature and active testis of different birds. Kumaran and Turner (1949) and Lofts (1962) suggested that the testosterone had no adverse effect on gonads in near maximum breeding condition, but spermatocytes. It is also suspected that the spermatokinetic effect of exogenous androgen is by way of direct action of the hormone on the testis (Lofts, 1962; Lofts et al., 1973). Brown and Follett (1977) showed that testosterone induced spermatokinetic effect was lost when birds were hypophysectomized before treatment, and thus demonstrated the role of pituitary factors(s) in the stimulatory action of this androsteroid. Studied performed by Davies and Bicknell (1976) and others on different avian species have also documented the possible activation of the hypothalamo-hypophyseal system, particularly in relation to the secretion of that exogenous testosterone may have either pro- or anti-gonadal effect depending upon the sexual status of the bird (Tewary et al., 1985). They are also consistent with the studies on some mammalian species, which suggest a dose-dependent differential effect of testosterone (Berndtson et al., 1974).

Changing levels of thyroid hormones may also play an important role in determining the type and extent of the effects of the testosterone on neuroendocrine-gonadal axis from the late quiescent phase to the reproductive phase of annual reproductive cycle. In seasonal breeder, reproductive window is too small and, therefore, the animal needs to have an internal regulation. The advantage of having a testosterone-dependent mechanism is that an “avoidable activity” is slowed down, stopped or postponed only for the period when it is actually needed.

Detailed experiment on migratory redheaded bunting show that the testosterone except suppressing the seasonal decline and causing an insignificant increase has no influence on the body mass. Testosterone species, the absence of an influence during regressive and quiescent phase on testis by a high or a low dose of testosterone suggests that the neuroendocrine-gonadal axis was inactive and the levels were not high enough to act directly at the germinal epithelium (Thapliyal and Singh, 1995).

The conclusion of current study demonstrate the effect of TP on the body weight and testes of male brahminy myna. Brahminy myna. The results are shown in figure 1a. The mean body mass was slightly increased after 30 days among all the four groups, exposed to 8L:16D The testis volume of 50µg TP group was slightly stimulated but the testis volume of 75µg TP group was significantly stimulated upto day 30. At low doses, circulating levels of testosterone remain normal or below normal and, therefore, TP produces an antigonadal response by the negative feedback actions on the hypothalamo-hypophyseal (h-h) system (Stetson, 1972). But, once the circulating levels become sufficiently higher after administration of high doses, TP directly acts on the seminiferous tubules leading to stimulation and/or maintenance of the growth of the regressed testes (Desjardins and Turek, 1977). Sharma et al., (2007) have reported that low dose of exogenous testosterone propionate (TP) did not modulate the photoperiodism in brahminy myna (Sturnus pagodarum).

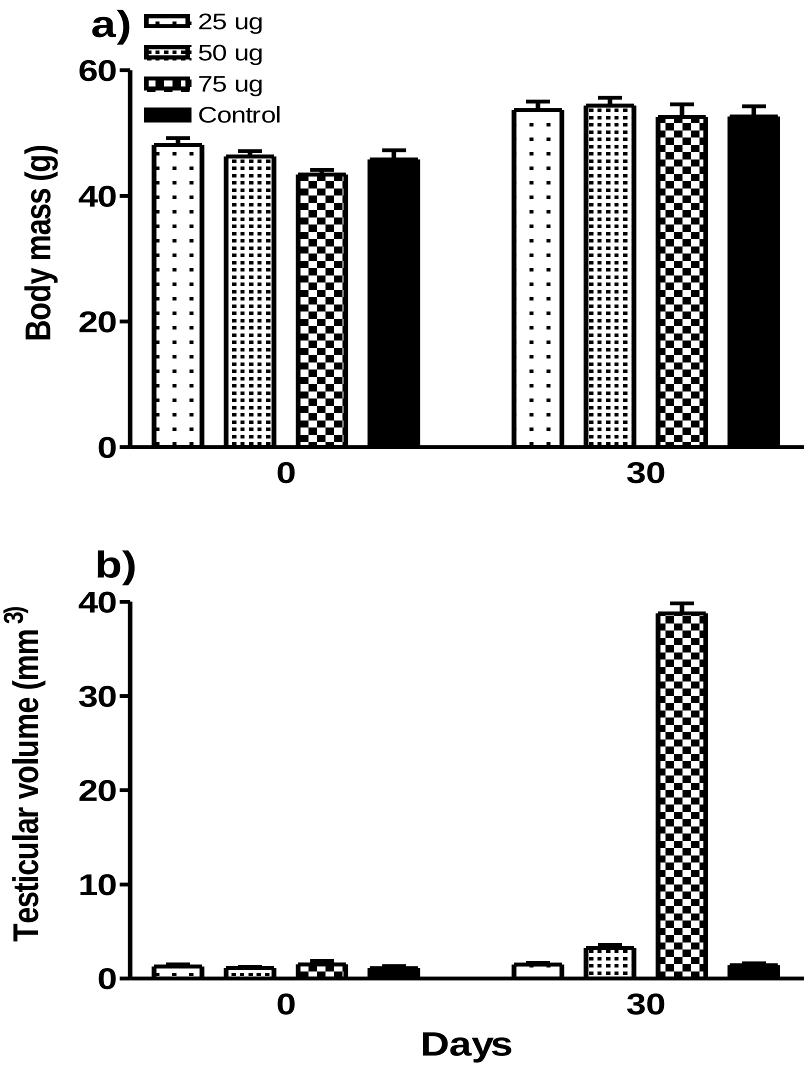

Figure 1: Changes (mean ± SE) in body mass (a) and testis volume (b) of photosensitive male brahminy myna. Four groups (1-4) of birds were subjected to short day length (8L:16D), and received olive oil (0.1 ml), 25 μg TP, 50 μg TP and 75 μg TP per bird on alternate day respectively. Each symbol represents the mean and the vertical line on it indicates the standard error.

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