ENDOCRINE REGULATION OF BODY WEIGHT IN THE SPOTTED MUNIA, *UROLONCHA PUNCTULATA*

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Literature on the body-weight cycles of nonmigratory birds is meager (Nice 1937, 1938, 1946; Baldwin and Kendeigh 1938), and consequently the factors that regulate these cycles are only incompletely understood (Farner 1955). The mean body weight of a bird that has free access to food, it has been suggested, may change because of alteration in the level of the activity of the hypophysis (Wolfson 1952; Farner 1960; King and Farner 1963; Meier and Farner 1964) or of the gonads (Höhn 1947; see also review by Farner 1955), or even of the thyroid (Schildmacher and Rautenberg 1952). However, experimental investigations of the body-weight cycles have been confined mostly to migratory birds.

Recently Thapliyal (1966) and Thapliyal and Pandha (1966) have shown in the nonmigratory Spotted Munia, *Uroloncha punctulata*, that during the breeding phase the average weight of males is significantly higher than that of females (fig. 1). It has also been reported (Thapliyal 1966) that, while orchiectomy had no influence, thyroidectomy induced a rapid increase in the body weight of the birds, and after some time the mean body weights of the two sexes overlapped. To explain, it was suggested that the mechanisms that control the body weight of a Spotted Munia are independent of the gonads, gonadal hormones, and the gonadotropins but are quite sensitive to the activity of the thyroids (Thapliyal 1966).

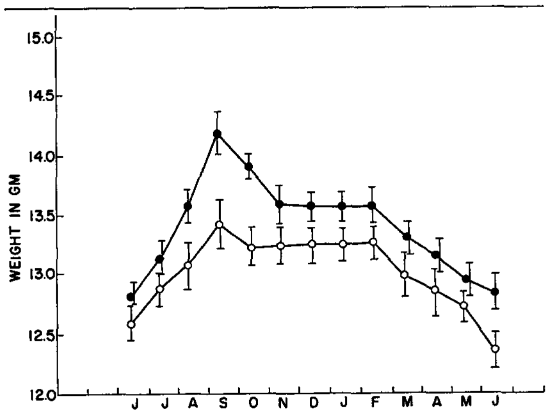

FIGURE 1. The annual cycle of body weight in male (upper curve) and female (lower curve) captive Spotted Munias kept outdoors. Data are shown as mean values ± 1 SE ($N = 12$ in each group).

Experiments were therefore planned to test the above suggestion by studying the effect of gonadal and gonad-stimulating hormones on the body weight of normal and gonadectomized birds and by comparing thyroid activity in the two sexes.

MATERIALS AND METHODS

The Spotted Munia is a nonmigratory ploceid that nests from July to October (Thapliyal and Pandha 1966). Adult males and females are similarly pigmented; juveniles initially lack the black pigmentation, but acquire adult plumage gradually through the spring and early summer months (Tewary and Thapliyal 1962).

In April, first-year juveniles were trapped from nature, and prior to use were kept in an outdoor aviary for about two months. The birds were kept in groups of four in wire cages (10.5 × 16.5 × 9 inches) with food (Kakun, *Setaria italica*) and water *ad libitum*. The cages were placed against the north window of a bird room (12 × 14 × 18 feet) that received unrestricted light. All the birds remained in good condition in this regime.

Birds were sexed by laparotomy, when some were gonadectomized also. Four days after the operation the birds were arranged in groups and treated as indicated in tables 1 and 2 and figure 2. Pregnant mare serum (PMS) injection experiments were performed during January, using freshly caught wild juveniles (table 3); radioiodine uptake was

TABLE 1. Initial and final body weights of normal and experimental juvenile female Spotted Munias.

Treatment[a]	Stage	Body weight, g (mean ± SE)[c] Control	Oöphorectomized
Saline injections	Initial, 4/6/66	13.55 ± 0.150	12.63 ± 0.412
	Final, 4/7/66	14.46 ± 0.286	13.98 ± 0.416
Testosterone injections[b]	Initial, 26/6/66	13.49 ± 0.203	13.71 ± 0.268
	Final, 26/7/66	13.86 ± 0.170	14.16 ± 0.183

[a] Eight birds in each group.
[b] Aquaviron (testosterone, aqueous suspension), Schering Asia, batch no. 6003, 1.5 mg injected on alternate days.
[c] For initial vs. final mean body weights, $P < 0.01$ in all paired groups.

TABLE 2. Initial and final body weights of normal and experimental juvenile male Spotted Munias.

Treatment[a]	Stage	Body weight, g (mean ± SE)[c] Control	Orchiectomized
Oil injections	Initial, 4/6/66	13.62 ± 0.225	13.46 ± 0.461
	Final, 4/7/66	14.68 ± 0.338	14.13 ± 0.301
Estradiol benzoate injections[b]	Initial, 26/6/66	14.20 ± 0.404	14.03 ± 0.204
	Final, 26/6/66	15.83 ± 0.369	14.89 ± 0.350

[a] Eight birds in each group.
[b] Schering Berlin, batch no. 3 Cl, in sesame oil.
[c] For initial vs. final mean body weights, $P < 0.005$ in all paired groups.

TABLE 3. Initial and final body weights of male and female Spotted Munias treated with serum gonadotropin (PMS).

Treatment[a]	Stage	Body weight, g (mean ± SE)[c] Female	Male
Saline injections	Initial, 9/1/66	13.21 ± 0.269	13.21 ± 0.270
	Final, 9/2/66	13.34 ± 0.250	13.40 ± 0.204
PMS injections[b]	Initial, 9/1/66	13.20 ± 0.193	13.25 ± 0.280
	Final, 9/2/66	13.58 ± 0.352	13.68 ± 0.196

[a] Eight birds in each group.
[b] Anteron, Schering Berlin, batch no. 1064-079, 50 IU injected on alternate days.
[c] For initial vs. final mean body weights, $P < 0.3$ in all paired groups.

measured in August, using freshly caught adults.

Birds (tables 1, 2, and 3) were weighed before and after the experiments, when castrates were also checked for gonadal regeneration. Gonadectomy in all birds included in the present study was complete.

Thyroidal uptake of radioiodine was measured *in vivo* at 2, 4, 6, and 24 hours after the birds were injected intramuscularly with a single dose of 5.7 μc of I^{131} in 0.2 ml of saline solution. Since the principal aim was to compare the rates of thyroid activity in the sexes and not to determine the net activity, an ordinary Geiger-Mueller detector served our purpose well. The thyroid region of each bird was exposed for a certain period of time to the open end of the detector placed at a fixed distance. Birds were not fasted before I^{131} injection and were maintained at room temperature. The data are expressed as counts per minute corrected for background.

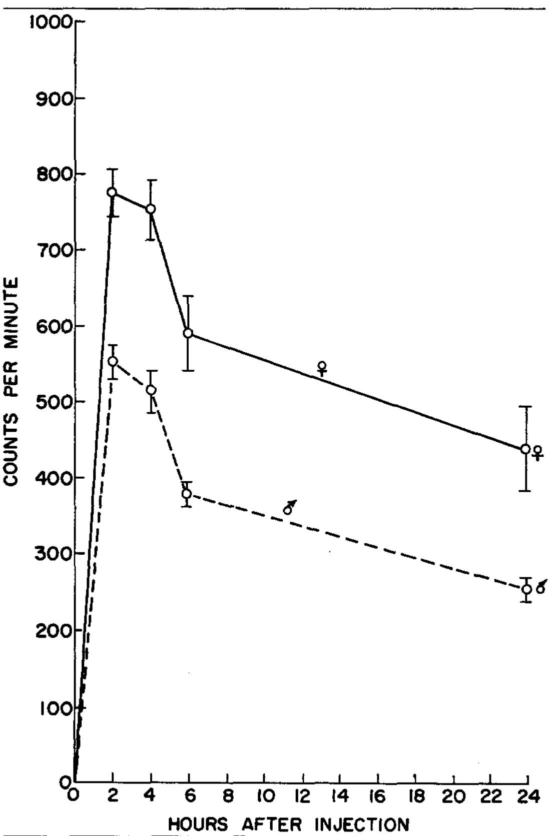

FIGURE 2. Thyroidal I^{131} uptake by male and female Spotted Munias after injection with 5.7 μc of carrier-free sodium iodide at hour zero. Data are shown as mean values ± 1 SE ($N = 20$ in each group).

Hormones were injected intramuscularly in 0.1 ml of the vehicle on alternate days over a month. Controls received sesame oil or normal saline only.

The statistical significance of difference between groups was tested by means of Student's t, which was computed on the basis of the difference between initial and final weights in individual birds (Fisher 1963:121).

OBSERVATIONS

Observations on the body weight of normal, gonadectomized, and hormone-treated males and females are summarized in tables 1 and 2, respectively.

Statistical analysis of the data of tables 1 and 2 clearly shows that there were significant increases in the body weights of all the groups of birds. Further, in the male series (table 2) the increase was higher than in the female ($P < 0.005$ for males and $P < 0.01$ for females). In the PMS-injected birds (table 3) there was no significant increase in the treated groups as compared with the control.

Maximum thyroid I^{131} occurred in both sexes within two hours after injection of the isotope. After maximum uptake, unlike in other species (see reviews by Kobayashi and Gorbman 1960; Kobayashi, Gorbman, and Wolfson 1960), there was rapid decline in the thyroidal radioiodine. It was observed that at each point the females gave a significantly higher count than the males (fig. 2).

DISCUSSION

Results of the present study fully confirm the suggestion of Thapliyal (1966) that gonads, gonadal hormones, and gonadotropins do not influence the body weight of the Spotted Munia. We are also able to confirm that the thyroid activity is higher in females than in males. Our results further indicate that the difference in the body weight of juvenile males and females first appears during late July. There was no significant difference between the mean body weights of the two sexes until late July, when males suddenly gained more weight than the females ($t = 1.3$, $P < 0.2$ for early July; $t = 5.09$, $P < 0.001$ for late July, [cf. tables 1 and 2]). It is of interest to note that July and August are also the months when the hypothalamo-hypophysial-gonadal axis of juvenile Spotted Munias first becomes active (Thapliyal and Pandha 1965).

Nevertheless, the results of PMS injection suggest that the gonad-stimulating hormones are without any influence on the body weight of Spotted Munias. In the Oregon Juncos (*Junco oreganus*) PMS also induced only gonadal growth. But, with Antituirin G, which contained somatotropic and other hormones, both gonadal development and fat deposition occurred (Wolfson 1945). On the other hand, increase in the body weight of hypophysectomized pigeons (Schooley 1944) and migratory White-crowned Sparrows, *Zonotrichia leucophrys gambelii* (Meier and Farner 1964), occurred as a result of treatment with prolactin. But prolactin had no effect on the body weight of a resident race of the Oregon Junco, *Juncos oreganus* (Wolfson 1945). Further, prolactin induces gonadal regression in a number of bird species, probably by suppressing the release of FSH from the hypophysis (Thapliyal and Saxena 1964). It therefore appears that the effects of prolactin on the gonad and body weight of different species of birds are not the same. In the Spotted Munia, body weight increases significantly when either prolactin (NIH-P-S4, ovine) or growth hormone (NIH-GH-S8, ovine) is administered (Asha Chandola and Thapliyal 1968). It therefore seems reasonable to suggest that increased output of the gonadotropic and luteotropic and (or) somatropic hormones from the adenohypophysis during July may be responsible for gonadal development and increase in the body weight of the Spotted Munia. However, results with mammalian gonadotropins are of limited value only, as the response of birds to these and to their own gonadotropins may not necessarily be the same. Further, higher mean body weight with low thyroid activity of male Spotted Munias as compared with that of females and the increase in the body weight of thyroidectomized birds leading to an overlap of the average body weights of the two sexes (Thapliyal 1966) strongly suggest that thyroid-stimulating hormone (TSH), acting by way of the thyroids, also plays an important role. It therefore appears that luteotropic hormone (LTH) or somatotropic hormone (STH), or both, directly, and TSH indirectly, acting by way of the thyroids, help in the control of the body weight of this species.

This possibility needs further investigation. Estimation of the growth-promoting, thyroid-stimulating, and gonad-stimulating hormones of the adenohypophysis of the thyroidectomized and normal Spotted Munia during different phases of the gonadal and body-weight cycles will be of special interest. There is also need to determine the level of thyroid activity in the early juveniles employing better radiochemical techniques, and to examine the roles of external factors that, acting by way of the central nervous system, activate the neurohumoral mechanisms of the hypothalamo-hypophysial complex which determine the time when gonads first start developing and male juvenile Spotted Munias put on more weight than the females.

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