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Role of thyroxine and prolactin in the testicular status of spotted munia (*Lonchura punctulata)*

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Abstract: *A long term investigation was made on the importance of thyroxine and prolactin in the reproduction of a tropical wild bird, spotted munia, Lonchura punctulata. Different doses of thyroxine i.m. (0.5, 1.0 and 2.0μg; 0.56, 1.12 and 2.24n mol Sodium salt, Sigma) per day/bird were administered in 0.1ml of 0.9% alkaline NaCl per day per bird. Similarly various doses of prolactin (1.0, 2.0,. and 4.0 i.u.) were given per day/bird in 0.1 ml of 0.9% alkaline NaCl .Almost normal testicular cycle was observed in vehicle treated birds.All three doses of thyroxine suppressed the cycle almost completely indicating a gonado- inhibitory nature of the hormone. Testicular development in all three prolactin treated groups was also inhibited in peak breeding time which indicates the antigonadal nature of this hormone in the reproduction of this bird.*

Key words: *Thyroxine, Prolactin, Testis, Spotted munia.*

Introduction

In several bird species thyroxine has been shown to be progonadal and in some others as antigonadal (Phillips *et al.,* 1985; Kar and Chandola, 1985; Sharp and Klandorf, 1985). While thyroidectomy inhibits testicular development in most species including young cockerels , ducklings (Benoit and Aron, 1934; Caridriot, 1943; Payne, 1944), injection of moderate doses of thyroid hormones promotes growth of the testis in young chickens (Wheeler *et al.,*1948; Kumaran and Turner, 1949) in adult domestic fowls (Greenwood and Blyth, 1942) and in drakes (Jaap, 1933; Aron and Benoit, 1934).

Also in some seasonally breeding wild birds such as house sparrow, red headed bunting, myna and the weaver finch thyroid seems to be progonadal as thyroidectomy causes gonadal regression and this can be overcome with thyroid hormone administration (Miller, 1935; Vangien, 1954; Thapliyal and Garg, 1969; Chaturvedi and Thapliyal, 1979). In contrast, the thyroid gland exerts an inhibitory influence upon gonadal growth and development in some other birds. For eg. in spotted munia, chestnut mannikin, red avadavat and European starling thyroidectomy causes gonadal recrudescence and abolishes seasonal regression (Thapliyal and Pandha, 1965; 1967; Thapliyal and Chandola, 1972; Wieselthier and Vantienhoven, 1972). Studies are also available on the annual thyroid hormone profiles of some birds including spotted munia (Pathak and Chandola, 1980; Tewary and Tripathy, 1985) in relation to the seasonal reproduction.

Light induced hormone conversion of T_4-T_3 regulate photoperiodic response of gonads in birds (Yoshimura *et al*., 2003). Yet literature on the effect of these factors on circulating T_4 and T_3 concentration are meagre (Klandorf *et al.,* 1978; Sharp and Klandorf 1985; Sharp *et al.,* 1986; Chaturvedi *et al.,* 1992). Apart from thyroid hormones prolactin is very often considerd to have a significant role in avian reproduction (Goldsmith, 1983). Higher concentration of prolactin in circulation has also been associated with low level of gonadotrophins and in some species, injection of prolactin is known to induce gonadal regression indicating the antigonadal role of the hormone (Lofts and Marshall, 1956). However, almost nothing is known on the possible role of prolactin in the regulation of reproduction in tropical birds. Keeping in mind the paucity of informations on the involvement of thyroid hormones and prolactin an attempt was made to reaveal the effects of thyroxine and prolactin in seasonal reproduction of these birds.

Materials and Methods

Thyroxine and prolactin treatment schedule: In the first week of June adult spotted munia were procured and acclimatized to laboratory conditions for 14 days. Birds were then sexed by laparotomy and only males were used in the experiment. Five groups of 7 each were established in separate wirenet cages (20 x 16 x 14 in). Groups 1, 2 and 3 received i.m. 0.5, 1.0 and 2.0 μg (0.56, 1.12 and 2.24 n mol) of T_4 (sodium salt, Sigma) per day/bird respectively in 0.1 ml of 0.9% alkaline NaCl per day per bird. Group 4 received 0.1 ml vehicle/day. Group 5 without receiving anything served as control group. T_4 was prefered because of the fact that out of two thyroid hormones, T_4 and T_3, the former is reported to be more active than T_3 in the reproduction of birds (Follett and Nicholls, 1988; Kar and Chandola, 1985; Pares and Astier, 1985).

Every month size of the testis of each bird was measured *in situ* and gonadal volume was recorded. Also body weight of each bird was recorded on a fixed date (15th of every month). The study was terminated in the month of December once it covered the entire breeding period.

In the first week of July adult spotted munia were procured and were acclimatized to laboratory conditions for 14 days. The birds were then sexed and only males were used in the experiment. Five groups of 7 each were established in

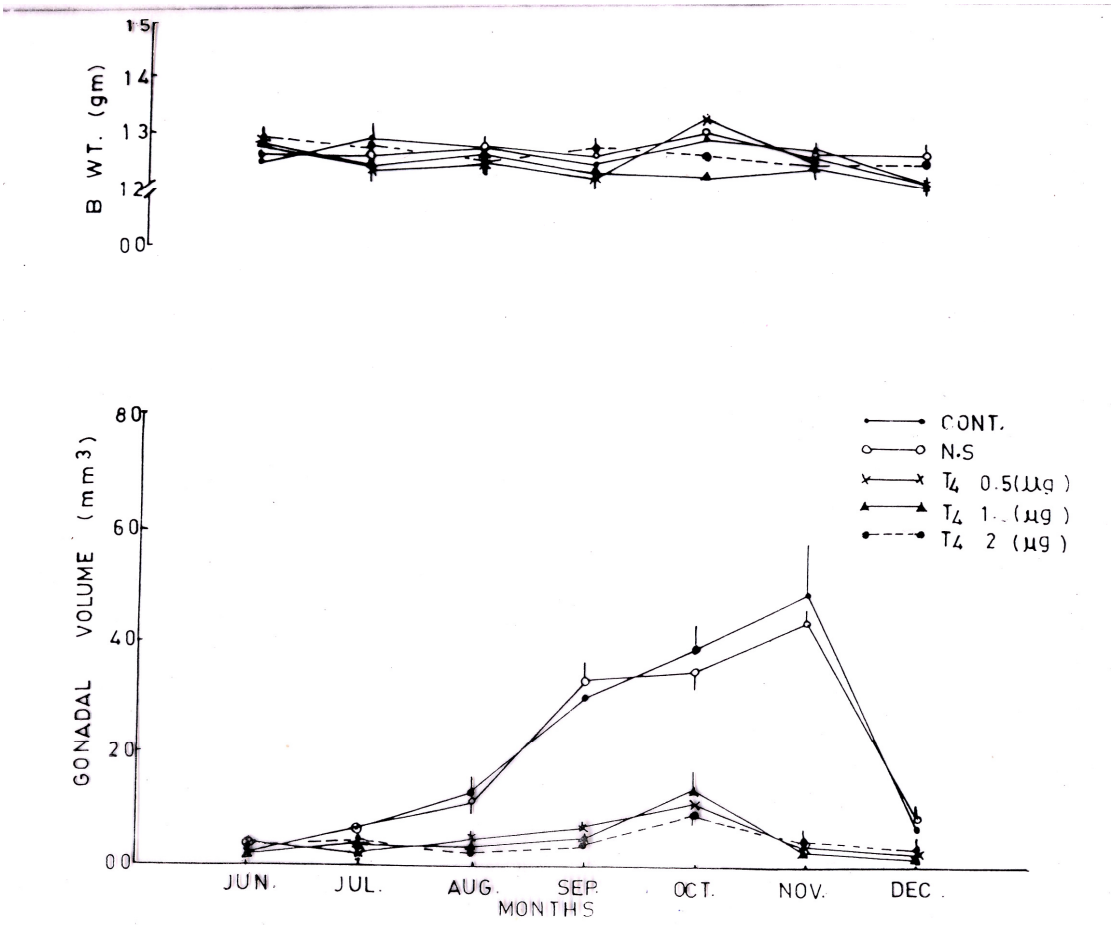

Fig. 1: Testicular cycle of spotted munia following different doses of T_4 or N. S. administration.

separate wire net cages. Birds of group 1, 2 and 3 received 1.0, 2.0 , and 4.0 i.u. of prolactin per day/bird respectively in 0.1 ml of 0.9% alkaline NaCl per day per bird. Group 4 received 0.1 ml vehicle/day and group 5 without receiving anything served as control group. This study was also terminated in December once it covered the entire breeding period. Every month the left testis of each bird was measured *in situ* and gonadal volume was recorded. Data of all the experiments were subjected to analysis of variance (ANOVA) and, where appropriate, further comparisons were made between the means by using student's `t' test.

Results and Discussion

Effects of thyroxine (T_4) (Fig. 1): Results are expressed in Fig. 1. In this bird almost normal testicular cycle was observed in vehicle treated birds, all three doses of thyroxine suppressed the cycle almost completely indicating the gonadoinhibitory nature of the hormones. ANOVA analysis indicated significant difference between the testicular volumes of different groups each month.

The testicular volume in group 1 (0.5 µg T_4 treated) was significantly less in the months of July and August (P, <0.01) in September, October and November (P, <0.001) and in December (P, <0.02) compared to the corresponding values of the control groups. In group 2 (1.0 µg T_4 treated) also the testicular volume was significantly less in the months of July, August and December (P, <0.01) and during September to November (P, <0.001). In group 3 also the testicular volume was significantly less in the months of July and December (P, <0.01); in August, September, October and November (P, <0.001) compared to the control value of the respective month. No significant difference in the body weight was observed in T_4 treated birds irrespective of the doses.

Effect of prolactin (Fig. 2): Gonadal development in all three prolactin treated groups was inhibited after August. ANOVA indicated significant differences in testicular volume of different groups each month from September to December.The testicular volume of prolactin (all three doses) treated birds were significantly less in the months of September, October, November (P, < 0.001) and in December, only in 2.0 and 4.0 i.u. treated groups (P, <0.01) for both compared to control values of the respective months.

When comparisons were made between the body weight of treated and control groups it was significantly more in all three prolactin treated groups from September to December

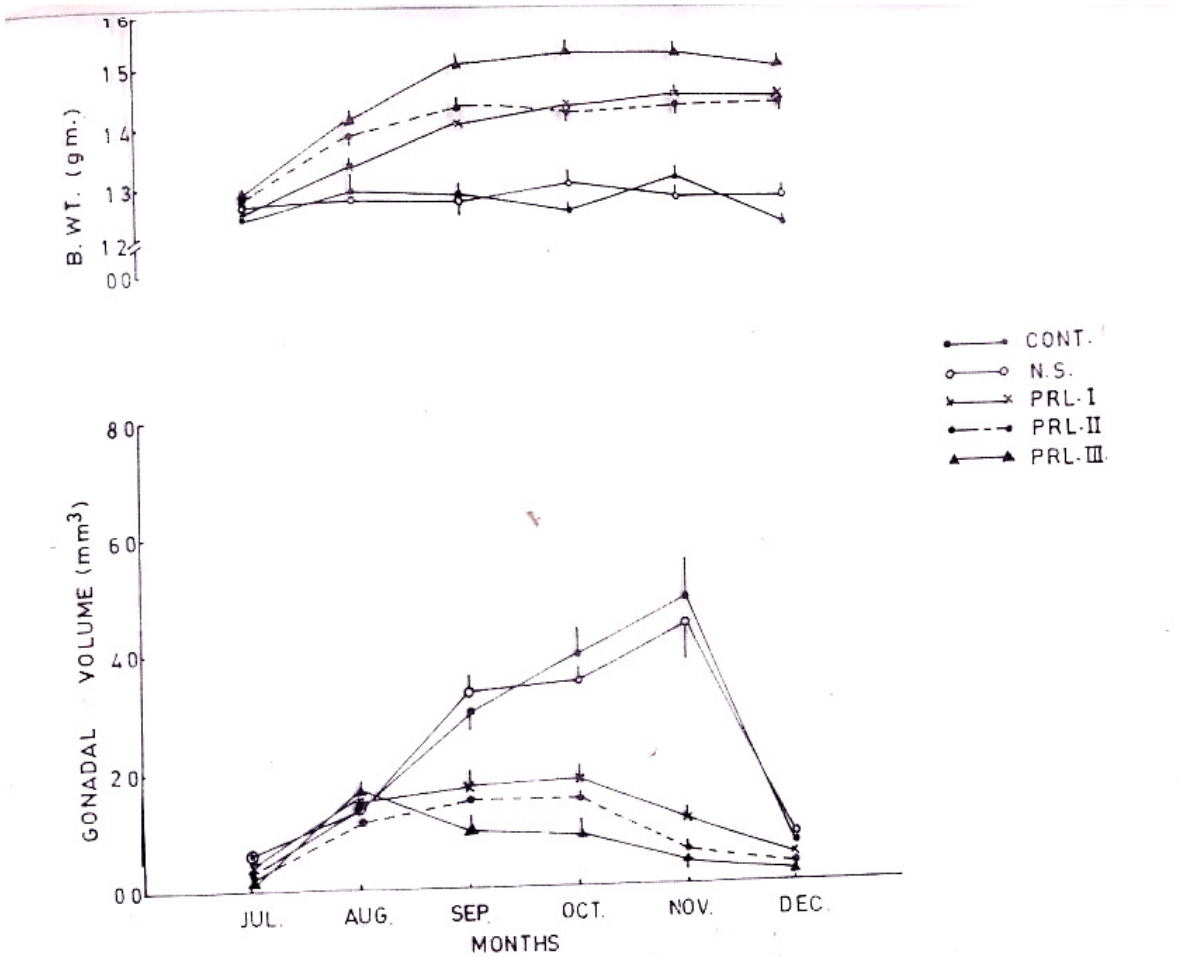

Fig. 2 : Testicular cycle of spotted munia following different doses of prolactin administration.

(P, <0.001, in all) and in August 1.0 and 2.0 i.u. treated groups, P being <0.05 and 0.001, respectively.

From the results of Fig. 1, it is clear that thyroxine (T_4) supresses the testicular development completely in spotted munia indicating the antigonadal nature of the hormone. Earlier report based on short term study in spotted munia also revealed the same (Chandola and Thapliyal, 1973 a, b; Kar and Chandola, 1985). However, no significant change in body weight was observed following T_4 administration as seen in female weaver bird (Chandola *et al.,* 1974).

Suppression of testicular development by chronic administration of T_4 has also been reported in European starling (Goldsmith and Nicholls, 1984a). However, reverse effect was seen in Rook (Lincoln *et al.,* 1980) and in Japanese quail (Follett and Nicholls, 1987).

Although exact mechanism of T_4 action in the alteration of gonadal function is not known in these birds, from the literature on other birds (Follett and Nicholls, 1988) it appears that T_4 may be highly active high in the photoneuroendocrine chain or directly at the gonadal level. Another possibility is that high concentration of T_4 induced photorefractoriness as observed in quail (Chaturvedi *et al.,* 1992) or it stimulated prolactin secretion which in turn inhibited the gonadal development as has been observed in European starling (Goldsmith and Nicholls, 1984 a,b).

Prolactin treatment for a long period suppressed the gonadal cycle in spotted munia indicating the gonado inhibitory role of the hormone (from the results of Fig. 2). Similar findings have also been reported in other birds such as pegions (Riddles and Bates, 1933), Cockerels (Yamashima, 1952)), passerine birds (Lofts and Marshall, 1956; Thapliyal and Saxena, 1964; Meiyer, 1969) and in tree pie (Chaudhari and Maiti, 1989). It is also reported to suppress photoperiodically induced gonadal growth in some birds (Bailey, 1950; Farner and Follett, 1966; Lofts and Murton, 1973).

However, prolactin failed to induce testicular regression in *Zonotrichia lucophry* and *Z. Gambelii* (Laws and Farner, 1960); *Carpodacus mexicanns* (Hammner, 1968); *Zonotrichia albicollis* (Meiyer, 1968) and *Lophorty californicus* (Jones, 1969). In spotted munia, prolactin induced gain in body weight is in accordance with the earlier report of Chandola and Pavgi (1979), according to which the prolactin induced weight

gain is not observed because of the alteration of total food consumption by the bird.

Present findings on testicular status in spotted munia clearly indicate that prolactin is gonadoinhibitory and probably high concentration of prolactin induces photorefractoriness in these birds as has been suggested in other birds (Dawson and Goldsmith, 1983; Sharp, *et al*., 1986) or it could be due to the direct suppression of FSH (Lofts and Marshall, 1956) or LH (Dawson and Goldsmith, 1983; Yoshimura *et al*., 2003) by the hormone.

Reviewing all the findings it appears that presence of thyroxine and/or prolactin is essential for the development and maintainence of testicular refractoriness.

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