CHAPTER 8

Effect of Long photoperiod (LD 18:6) on organ growth kinetics, histology and, serum hormone profile of corticosterone, T3, T4 and progesterone during post-hatched development

Introduction :

Studies on post-hatched body and organ growth have been carried out in the domestic fowl, to assesses the normal growth kinetics as well as to understand the influence of altered hormonal profiles, essentially those of thyroid hormones and growth hormone on the same (Singh *et al.*,1968; Bermudez *et al.*, 1983; Scanes *et al.*, 1984; Hayashi *et al.*, 1986; Yadav and Arneja, 1993). Though more attention had been paid to the histomorphological features of ovary and oviduct of adult laying hens, few studies on this line have also focused in the immature fowl (Williams and Sharp, 1978 a; Etches *et al.*, 1983; Sharp *et al.*, 1992). Similarly, most studies on the profile of serum corticosteroid and T_3 and T_4 are, in relation to ovulation and oviposition in hens, except for a few studies on hormonal profiles in the immature stages (Soliman and Hudson, 1974; Beuving and Vonder, 1977; May, 1978; Sharp and Beuving, 1978; Etches, 1979, Wilson and Cunningham, 1980).

Temporal studies on such aspects, in the immature stages, from hatch till sexual maturity, would be a useful paradigm to understand possible relationship if any, between pattern of changes during post-hatched development and attainment of sexual maturity and, features of egg laying performance in adult hens. Moreover, though photoperiodic manipulation has been increasingly used as part of poultry management for increasing egg productivity, the influence of such photoperiodic manipulations on body and organ growth kinetics, hormone profiles and histomorphology of ovary and oviduct, has never been studied. It is presumable that, alterations in attainment of sexual maturity and, qualitative and quantitative aspects of egg laying induced by photoperiodic manipulations, may be a consequence of the changes induced by photoperiod in the immature stages and hence, could provide valid morpho-physiological correlation. In this context, previous study had shown some influence of long photoperiod in the rearing stages, amounting to a step-down photic schedule, on attainment of sexual maturity, egg laying performance and egg composition (see Chapters 2, 5). The present study makes an attempt to assess the influence of a long photoperiod, on body and organ growth kinetics, histomorphology of ovary and, histological features of thyroid and adrenal, together with serum profile of T_3, T_4, corticosterone and progesterone, during the period of exposure and, to relate these changes with the previously reported effects on sexual maturity and egg laying performance.

Materials and Methods :

As detailed in Chapter 1.

Results :

Body and organ weights :

The body weight of LP chicks was similar to that of NLD chicks at 30 and 90 days, though at 60 days it was greater than NLD chicks. The growth rate of LP chicks was similar from 0-30 days, significantly more between 30 and 60 days and less between 60-90 days, compared to that of NLD chicks (fig. 1). The weight of thyroid of LP chicks was lesser at 30 days (by 25%) while that at 60 and 90 days was greater (by 15.2% and 25.75% respectively) than that of NLD chicks (Table1) (fig. 1). The growth rate of thyroid which was lower between 0-30 days, showed a higher rate between 30-60days and between 60 and 90 days, compared to that of NLD chicks. The adrenal showed a reduced growth rate in LP chicks, with lower weights between 0-30 days and 60-90 days. The ovary of LP chicks was heavier than the NLD chicks at both 60 and 90 days, with a maximal and significantly greater growth rate between 30 and 60 days. The oviduct of LP chicks showed reduced growth rate between 0-30 and 60-90 days and significantly greater rate between 30-60 days, with the result, the oviduct weighed significantly more at 60 days and less at 90 days (fig. 2a,b). The overall growth kinetic ratio showed a significantly greater growth rate for thyroid and ovary and, lesser for adrenal and oviduct of LP chicks. Whereas in the case of oviduct, the growth kinetic ratio was higher relative to NLD throughout, that of thyroid was higher between 30-90 days, with a lower ratio between 0-30 days. Both the adrenal and oviduct of LP chicks, showed a similar pattern of growth kinetic ratio with higher ratios between 30-60 days and lower between 60-90 days (Table 1). The absolute weights and relative weights of thymus, bursa and spleen showed an increment at 60 days, whereas, liver showed a decrement (fig. 2c,d). However, at 90 days the relative weights of liver and thymus were significantly decreased. The overall body growth rate of LP chicks was higher than the NLD chicks. The overall growth rates and growth indices of thyroid and ovary were increased and, that of adrenal and oviduct were decreased. The liver showed an overall decrement in the growth rate and growth indices, whereas, the lymphoid organs showed marginal changes (Tables 3,4).

Hormonal changes :

Both NLD and LP chicks showed a similar trend of decreasing CORT and T_3 levels from 30 to 90 days with, maximum decrease being registered at 60 days. The T_4 however showed almost a constant level in NLD chicks, whereas in LP chicks, it showed continuous decrease, with maximum decrease being registered at 90 days. Though the concentration of CORT was significantly higher in LP chicks at 30 days, it was significantly lower at 60 and 90 days. The levels of T_3 and T_4 were significantly higher in LP chicks at all ages compared to NLD chicks. The serum progesterone level showed a similar trend of decrease with age, with maximum decrement at 60 days in both NLD and LP chicks. The concentration of progesterone was significantly lower at 30 days and, higher at 60 and 90 days in LP chicks, compared to NLD chicks (Table 5)(fig. 3).

Histological observations :

Thyroid : The thyroid of NLD chicks showed medium sized follicles with cuboidal epithelium and varying contents of colloid at 30 days. At 60 days, the epithelial cell height was reduced and, the follicles showed increased colloid content. By 90 days, the follicles were enlarged with rich colloid content and reduced cell height. In contrast, the thyroid of LP chicks showed more colloid filled follicles with slightly reduced cell height at 30 days. At 60 days, the follicles were small to medium sized with, rich colloid content and low cuboidal epithelium. Few of the follicles depicted depletion of colloidal content. Even at 90 days, the follicles were small to medium sized with full colloid content though, many more follicles were empty compared to 60 days (plate 1).

Adrenal : The adrenal of 30 day old NLD chicks, showed prominent active cortical cords with relatively less but active medullary cords. At 60 days, the cortical cords appeared very prominent but less active with condensed nucleus. There were signs of medullary secretion. By 90 days, the cortical cords were well formed with active looking cells and depicting secretory exhaustion. Both the cortical and medullary cords were prominent and active in LP chicks right from 30 days. There was progressive hypertrophy and secretory exhaustion as marked by vacoulisation through 60 and 90 days (plate 2).

Ovary : At 30 days, the ovary of NLD chicks showed many primordial and primary follicles. These follicles underwent progressive enlargement and growth through 60-90 days. At 60 days, the stromal tissue was hypertrophied with signs of differentiation into interstitial glands. The granulosa was prominent and thecal condensation had started by 90 days. The follicles were enlarged with well formed theca and yolk granules. The interstitial glands were well developed. By contrast, in LP chicks the ovary showed precocious enlargement of follicles with thecal differentiation and yolk deposition by 30 days itself. By 60 days, both the granulosa and theca were hypertrophied and active with further enlargement of follicles. By 90 days, progressive development of follicles was evident, but the granulosa and theca appeared to be less active. Overall, the ovary of LP chicks seemed to have more number of follicles than that of NLD chicks (plate 3,4,5).

The histometrics of the ovarian follicles (table 6) shows a temporal progression from 6-30 μm to 240-440 μm sized follicles from 30-90 days in both NLD and LP chicks. Though the total number of follicles appeared

Table 1. Changes in body weight (in gms) and absolute and relative weights (in mg) of thyroid, adrenal, ovary and oviduct in NLD and LP pullets.

	One day old chicks		30 days		60 days		90 days	
			absolue wt.	relative wt.	absolue wt.	relative wt.	absolue wt.	relative wt.
Body weight	26.63 ±3.43	**NLD**	117.23 ±16.2	--	312.85 ±18.22	--	600.0 ±16.32	--
		LP	120.0 ±10.80	--	317.5 ±5.65	--	640 ±8.96*	--
Thyroid weight	4.33 ±0.40	**NLD**	12.00 ±.81	10.23 ±.77	19.66 ±1.20	6.28 ±.63	33.00 ±1.86	5.50 ±.59
		LP	9.00 ±.40**	7.5 ±.63**	22.66 ±1.02*	5.86 ±.72*	41.5 ±.86***	6.80 ±.71
Adrenal weight	12.75 ±3.92	**NLD**	21.5 ±1.64	18.33 ±1.88	30.60 ±1.24	9.78 ±.98	68.0 ±2.44	11.33 ±1.03
		LP	20.66 ±1.69	17.21 ±2.10	39.00 ±.70***	10.08 ±1.12	55.66 ±2.71**	9.12 ±1.08
Ovary weight	22.66 ±4.26	**NLD**	34.63 ±4.03	28.99 ±3.39	65.20 ±2.93	20.84 ±2.23	116.33 ±9.31	19.38 ±2.90
		LP	35.66 ±1.64	29.71 ±3.71	164 ±11.27***	42.4 ±3.3***	188.6 ±8.1***	30.92 ±3.66*
Oviduct weight	3.75 ±0.27	**NLD**	21.4 ±2.52	18.79 ±2.02	57.33 ±3.19	18.32 ±2.23	112.3 ±1.88	18.72 ±3.95
		LP	16.00 ±.57*	13.33 ±.78*	71.0 ±1.87***	18.36 ±1.07	95.33 ±0.23***	15.62 ±1.11

Values : Mean ± SE, n=12 ,* P<.05, **P<.005, ***P<.0005.

Table 2. Changes in absolute and relative weights (in gms) of liver and lymphoid organs of chicks under NLD and LP.

	One day old chicks		30 days		60 days		90 days	
			absolute wt.	relative wt.	absolute wt.	relative wt.	absolute wt.	relative wt.
Liver weight	0.89 ±0.07	NLD	3.48 ±.14	0.297 ±.30	6.44±.19	0.206 ±.12	11.41 ±.218	0.190 ±.04
		LP	4.03 ±.32	0.335 ±.24	8.43 ±.15***	0.218 ±.06	10.16 ±.210***	0.166 ±.08***
Thymus weight	0.193 ±0.049	NLD	0.292 ±.03	0.248 ±.01	1.282 ±.012	0.409 ±.008	2.12 ±.218	0.354 ±.01
		LP	0.258 ±.01	0.215 ±.01	1.624 ±.27	0.420 ±.04	1.67 ±.086*	0.273 ±.006*
Bursa weight	0.083 ±0.017	NLD	0.148 ±.00	0.126 ±.01	0.450 ±.016	0.143 ±.019	1.5 ±.289	0.261 ±.019
		LP	.095 ±.002***	.079 ±.008***	1.502 ±.097***	0.388 ±.03***	1.65 ±.071*	0.21 ±.03*
Spleen weight	0.150 ±0.085	NLD	0.137 ±.019	0.116 ± .017	0.528 ±.005	0.108 ±.014	0.72 ±.021	0.120 ±.005
		LP	0.085 ±.011*	.070 ±.003*	0.589 ±.046	.152 ±.014***	0.74 ±.004	0.122 ±.008

Values : Mean ± SE, n=12 ,* P<.05, **P<.005, ***P<.0005.

Table 3. Monthly growth rate and Growth indices of body and organs of NLD and LP chicks.

		30 days		60 days		90 days		overall	
		growth rate	growth index	growth rate	growth index	grwoth rate	grwoth index	growth rate	growth index
Body weight	NLD	3.02	--	6.51	--	9.57	--	6.37	--
	LP	3.12	--	8.88	--	7.44	--	6.48	--
Thyroid weight	NLD	0.255	0.084	0.255	0.039	0.444	0.046	0.318	0.049
	LP	0.155	0.049	0.455	0.051	0.628	0.084	0.413	0.063
Adrenal weight	NLD	0.219	0.096	0.303	0.046	1.24	0.129	0.613	0.096
	LP	0.263	0.084	0.611	0.068	0.555	0.074	0.433	0.064
Ovary weight	NLD	0.399	0.132	1.01	0.155	1.70	0.177	1.04	0.163
	LP	0.433	0.138	4.27	0.48	0.822	0.110	1.84	0.183
Oviduct weight	NLD	0.588	0.194	1.19	0.182	1.83	0.191	1.20	0.188
	LP	0.408	0.130	1.83	0.206	0.811	0.109	1.01	0.155

Values : Mean

Table 4. Monthly growth rates and growth indices of Liver and Lymphoid organs of NLD and LP chicks.

		30 days		60 days		90 days		overall	
		growth rate	growth index	growth rate	growth index	grwoth rate	grwoth index	growth rate	growth index
Liver weight	NLD	0.086	0.028	0.098	0.015	0.165	0.017	0.116	0.018
	LP	0.131	0.041	0.146	0.0164	0.057	0.0076	0.111	0.017
Thymus weight	NLD	0.0033	0.001	0.033	0.005	0.027	0.002	0.021	0.003
	LP	0.0021	0.0006	0.045	0.005	0.0015	0.0002	0.016	0.0024
Bursa weight	NLD	0.0021	0.0006	0.010	0.001	0.037	0.003	0.016	0.002
	LP	0.0004	0.0001	0.046	0.0051	0.0051	0.0006	0.017	0.0002
Spleen weight	NLD	0.0004	0.0001	0.013	0.001	0.006	0.0006	0.006	0.0009
	LP	0.0021	0.0006	0.016	0.0018	0.0051	0.0006	0.0066	0.0010

Values : Mean

Table 5. Changes in serum corticosterone, T_3, T_4 and progesterone and their corresponding ratios in NLD and LP pullets.

		30 days	60 days	90 days
CORT	**NLD**	2.11 ±0.37	0.71 ±0.033	0.345 ±0.042
	LP	3.59 ±0.48*	2.77 ±0.20***	1.64 ±0.45*
T_3	**NLD**	0.690 ±0.073	0.528 ±0.029	0.593 ±0.089
	LP	1.21 ±0.086***	0.617 ±0.074	0.821 ±0.073*
T_4	**NLD**	3.016 ±0.237	3.03 ±0.183	3.18 ±0.154
	LP	4.65 ±.493*	4.13 ±0.152***	3.99 ±0.352
Progesterone	**NLD**	0.511 ±0.013	0.120 ±0.013	0.266 ±0.006
	LP	0.293 ±0.024***	0.207 ±0.013***	0.340 ±0.021**
$T_3 : T_4$	**NLD**	0.288	0.174	0.186
	LP	0.26	0.149	0.205
T_3 : CORT	**NLD**	0.278	0.236	0.286
	LP	0.337	0.222	0.5
T_4 : CORT	**NLD**	1.216	1.35	1.53
	LP	1.295	1.49	2.43

Values : Mean ± se

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		30 days	60 days	90 days
T_3 : Body weight	NLD	0.0058	0.0016	0.0009
	LP	0.0100	0.0015	0.0013
T_4 : Body weight	NLD	0.025	0.0092	0.0053
	LP	0.038	0.010	0.0065
T_3 : Thyroid weight	NLD	0.057	0.026	0.0179
	LP	0.134	0.027	0.0197
T_4 : Thyroid weight	NLD	0.251	0.154	0.0963
	LP	0.516	0.182	0.0961
CORT : Body weight	NLD	0.210	0.0071	0.0034
	LP	0.029	0.0071	0.0026
CORT: Adrenal weight	NLD	0.115	0.072	0.030
	LP	0.173	0.071	0.029

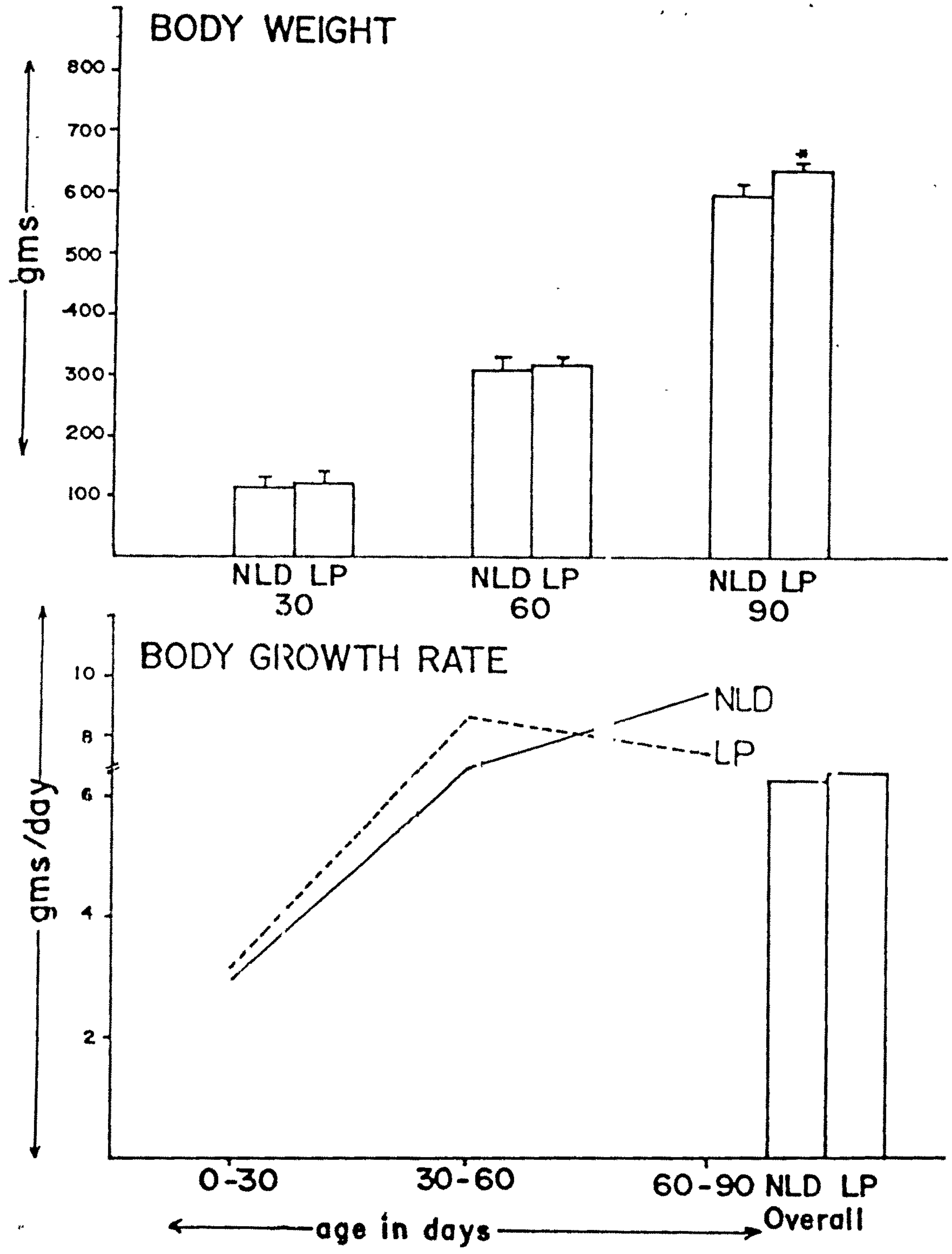
Values : Mean

Table 6. Histometrics of the ovarian follicles of birds under NLD and LP.

			S_1 (<30µm)	S_2 (31-90µm)	S_3 (91-120µm)	B1 (121-240µm)	B2 (241-440µm)	S (6-200µm)	B (200-300µm)	L (>300µm)	Total
30 days	NLD	POF	23 (38.3%)	29 (48.3%)	3 (5%)	5 (8.3%)	--	58	2	--	60
		AF.	2 (8.6%)	--	--	--	--	--	--	--	2 (3%)
	LP	POF	10 (13.5%)	57 (72%)	10 (13.5%)	--	--	74	--	--	74
		AF.	4 (40%)	12 (22.2%)	2 (20%)	--	--	--	--	--	18 (24%)
60 days	NLD	POF	21 (19.1%)	35 (48.6%)	7 (9.7%)	6 (8.3%)	3 (4.1%)	66	6	--	72
		AF.	10 (21.2%)	3 (8.5%)	1 (14.2%)	1 (16%)	--	--	--	--	12 (16%)
	LP	POF	--	18 (38.2%)	4 (8.5%)	13 (27.6%)	2 (4.2%)	32	10	5	47
		AF	--	5 (28.7%)	1 (25%)	4 (30%)	--	--	--	--	10 (21.2%)
90 days	NLD	POF	29 (34.9%)	25 (47.1%)	5 (9.4%)	17 (32%)	6 (11.3%)	35	14	4	53
		AF	--	11 (44%)	2 (40%)	3 (17.6%)	--	--	--	--	16 (30.8%)
	LP	POF	29 (34.9%)	37 (44.5%)	4 (4.8%)	8 (9.6%)	5 (6%)	73	5	5	83
		AF	--	--	2 (50%)	2 (25%)	--	--	--	--	4 (4.8%)

Values : Mean

Fig. 1. Body weight and body growth rates of NLD and LP chicks.



*-P<.05, **-P<.005, ***-P<.0005

Fig. 2a. Absolute and relative weights of thyroid and adrenal (in mg) of NLD and LP chicks

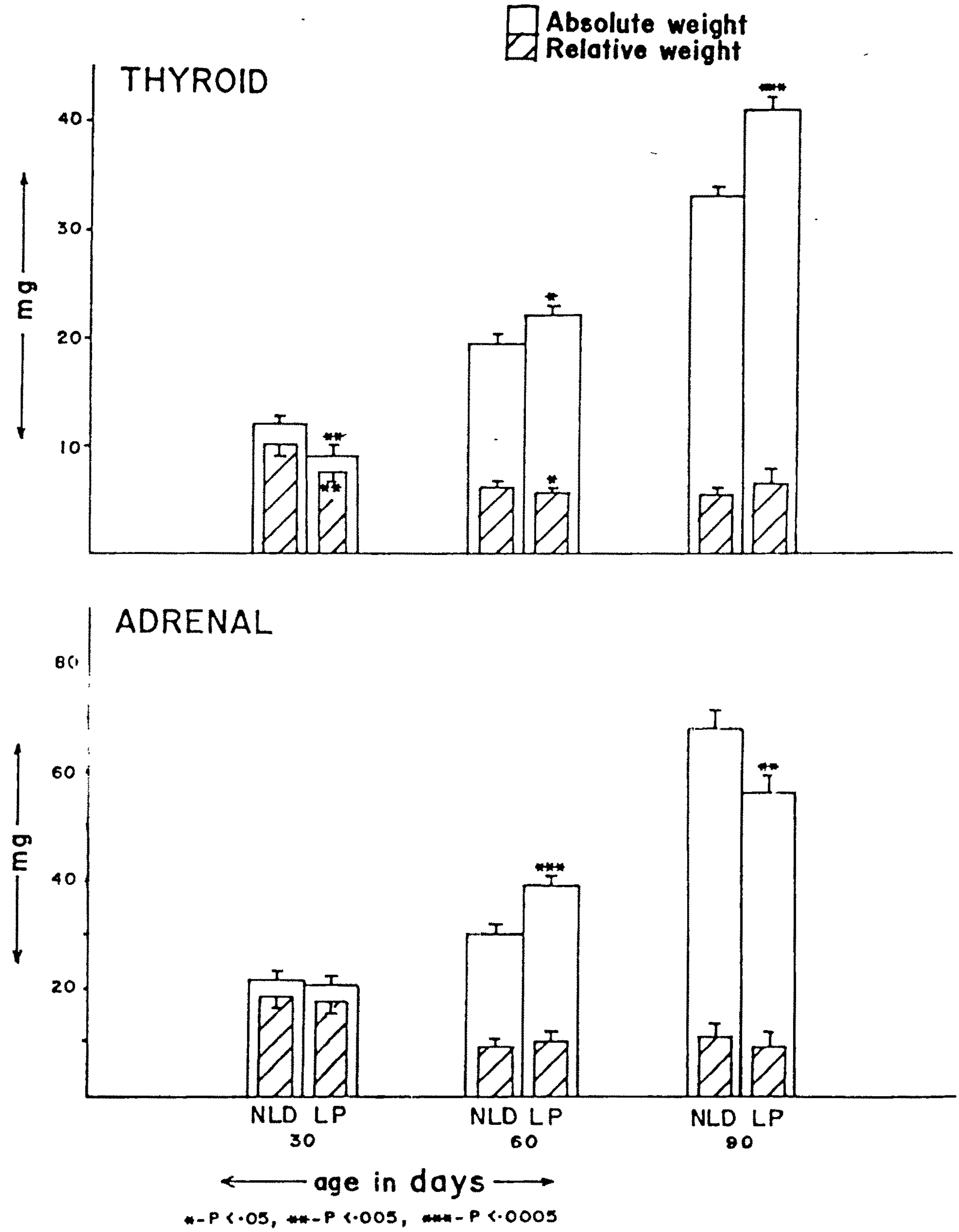


Fig. 2b. Absolute and relative weights of ovary and oviduct (in mg) of NLD and LP chicks.

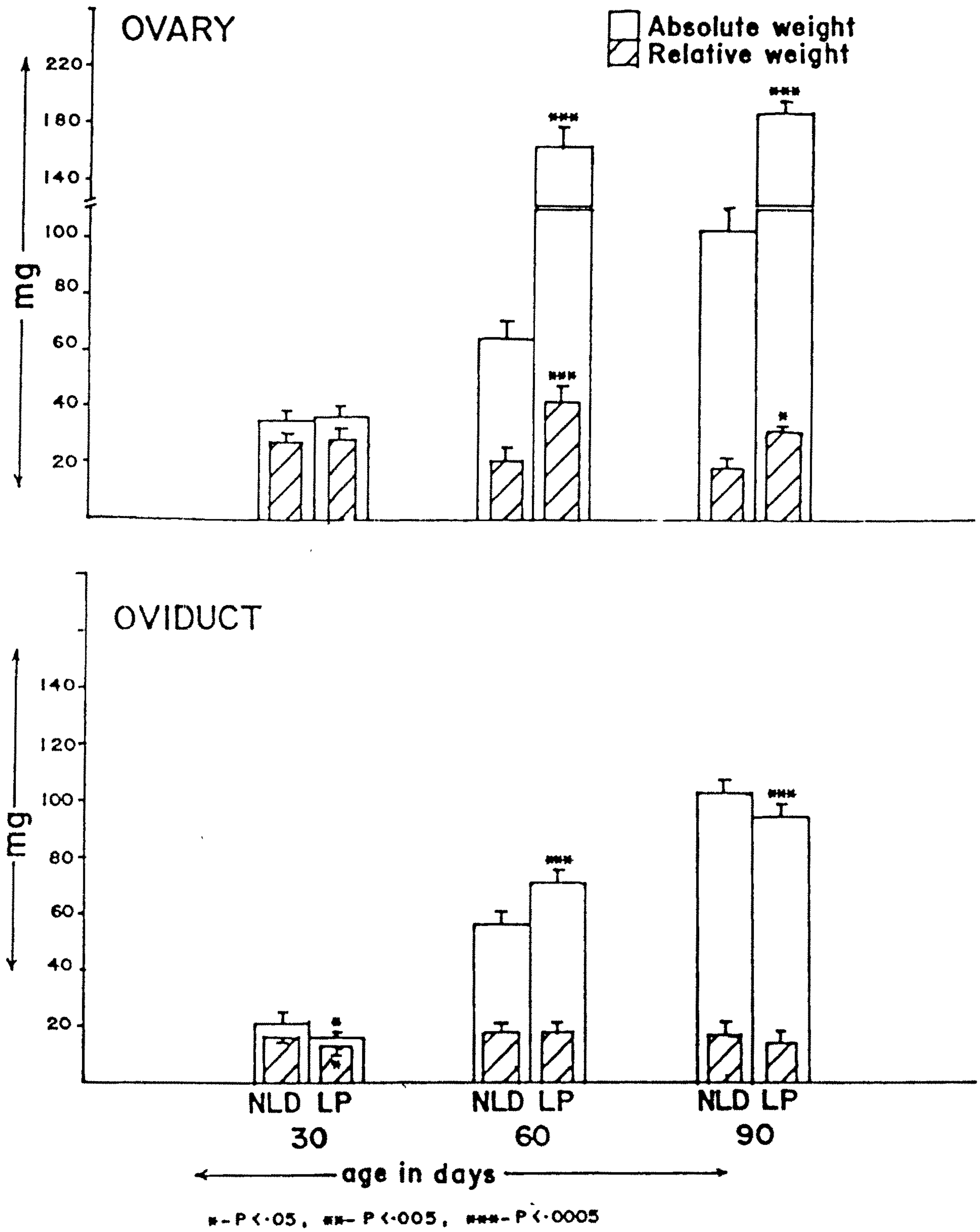


Fig. 2c. Absolute and relative weights of liver and thymus (in gms) of NLD and LP chicks.

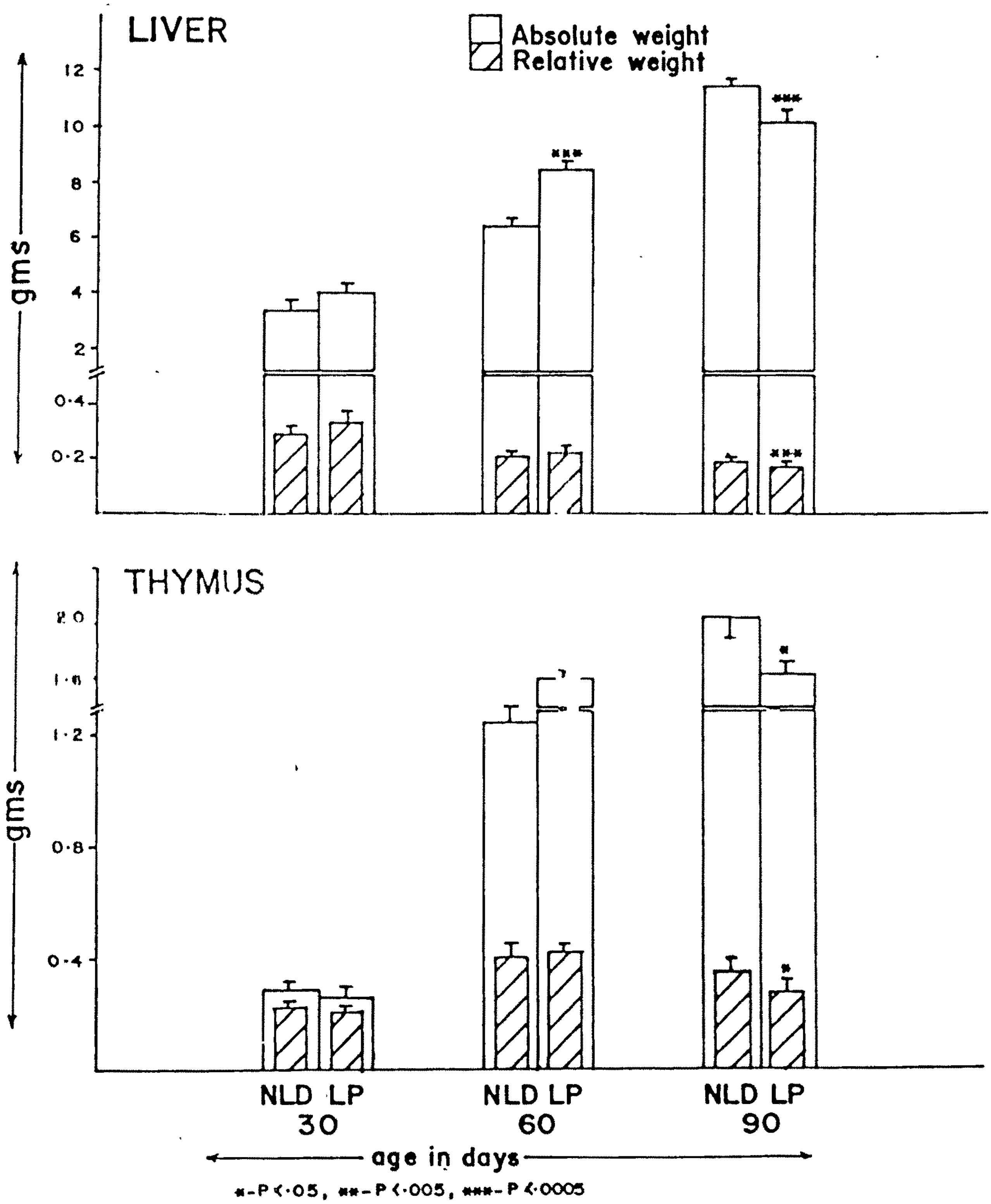


Fig. 2d. Absolute and relative weights of bursa and spleen (in gms) of NLD and LP chicks.

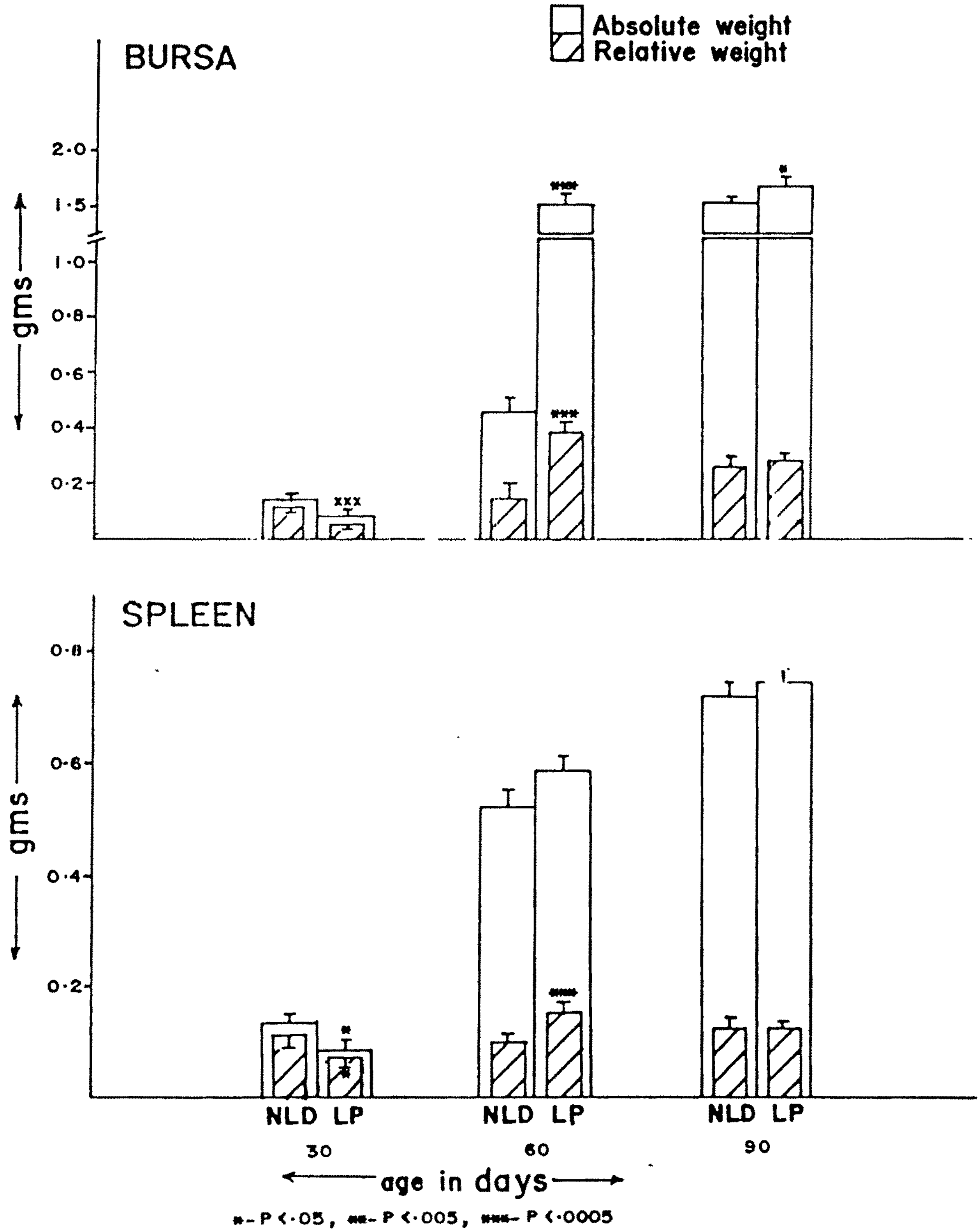


Fig 3. Serum hormone levels of NLD and LP chicks at 30, 60 and 90 days.

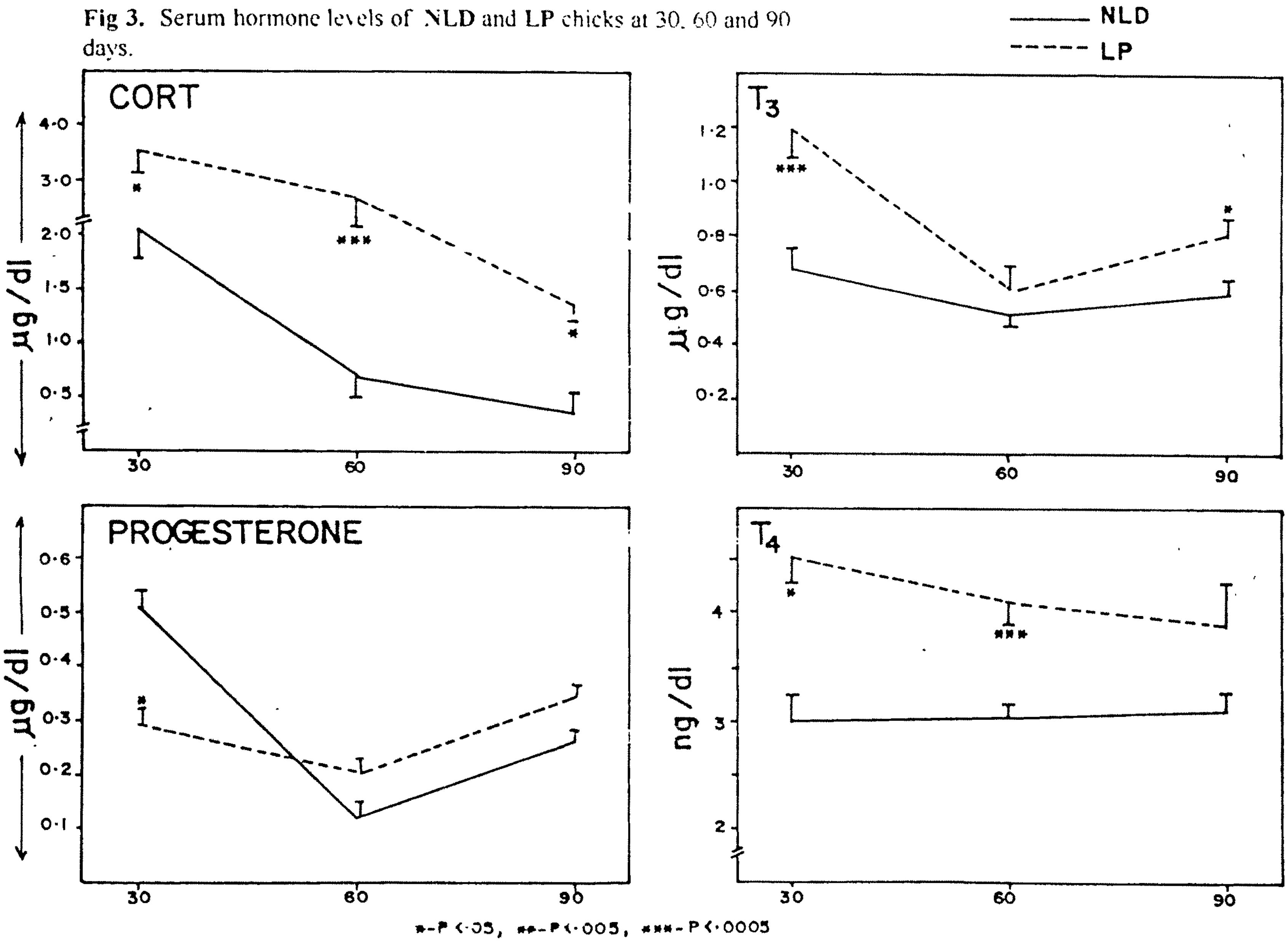


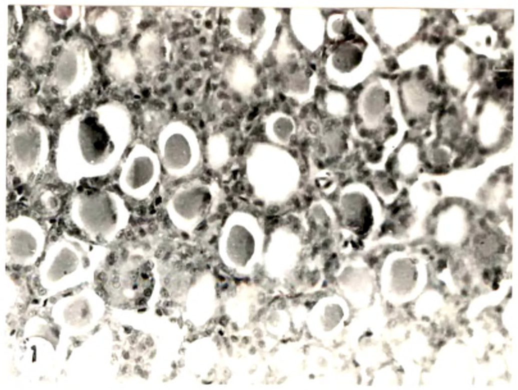
Plate 1 (Figs. 1-6)

Photomicrographs of thyroid of NLD (control) and LP chicks (320 x).

Fig. 1. Thyroid of 30 day control chick showing medium to large sized follicles with varying contents of colloid and a cuboidal follicular epithelium.

Figs. 2-3. Thyroid of 60 and 90 day control chick showing a flat follicular epithelium and overall colloid retention.

Figs. 4-6. Thyroid of 30, 60 and 90 day old control chick showing cuboidal to low follicular epithelium. Some of the follicles colloid filled, whereas some show mild depletion of colloid.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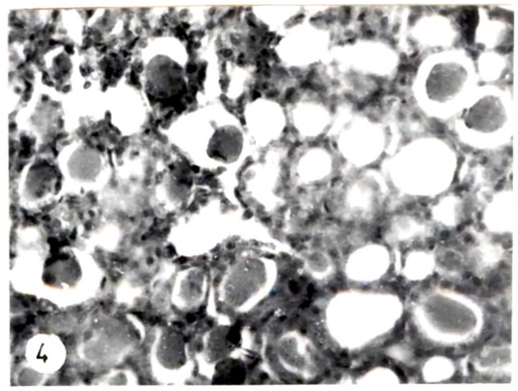
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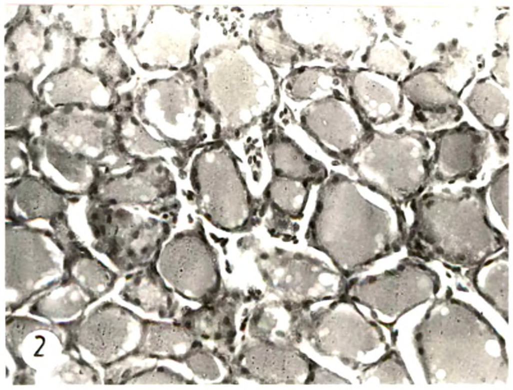
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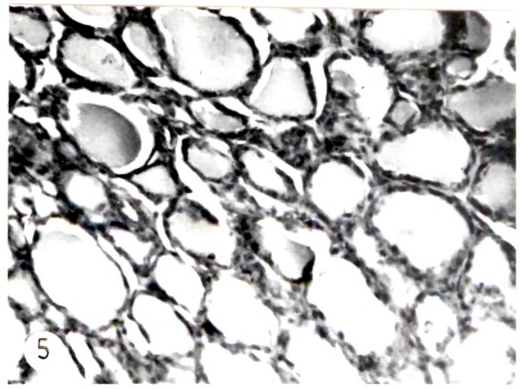
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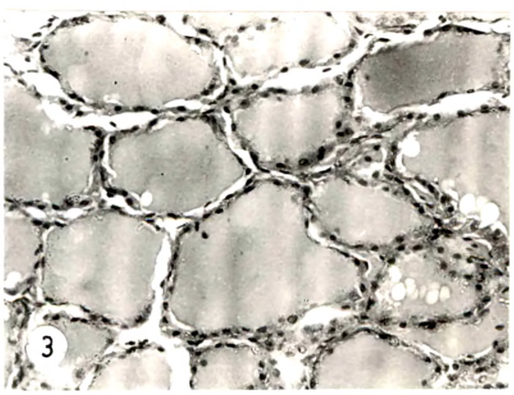
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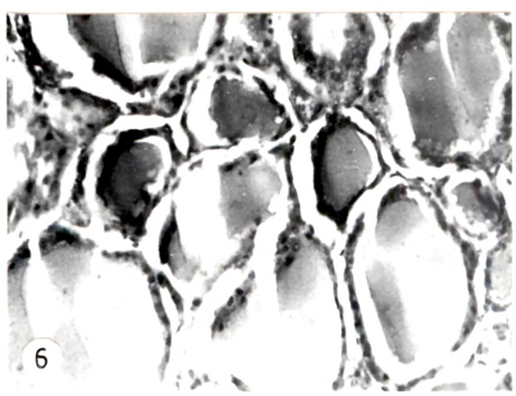
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Plate 2 (Figs. 7-12)

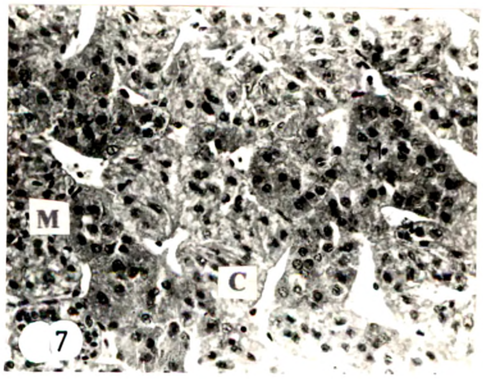
Photomicrographs of thyroid of NLD (control) and LP chicks (320 x).

Fig. 7. Adrenal of 30 day control chick showing prominent and active medulla.

Fig. 8. Adrenal of 60 day control chick. Note the condensation of nuclear elements in cortex. Medullary secretion indicated.

Fig. 9. Adrenal of 90 day control chick. Cortical cords well formed with active cells and showing secretory exhaustion. Medullary cell activity prominent.

Figs. 10-12. Adrenal of 30, 60 and 90 days old control chick showing prominent cortical cords with secretory exhaustion. Medullary cells also appear to be active.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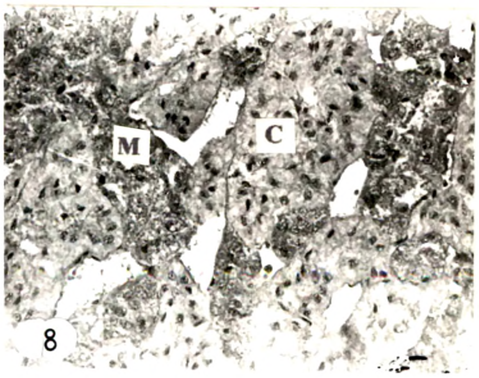
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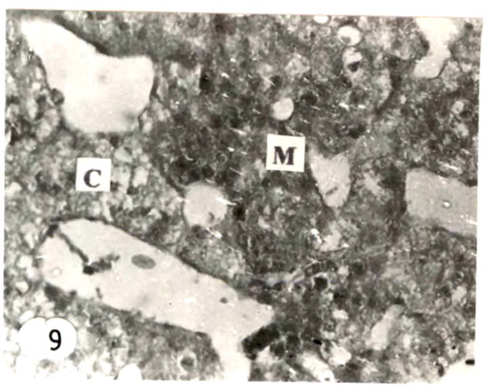
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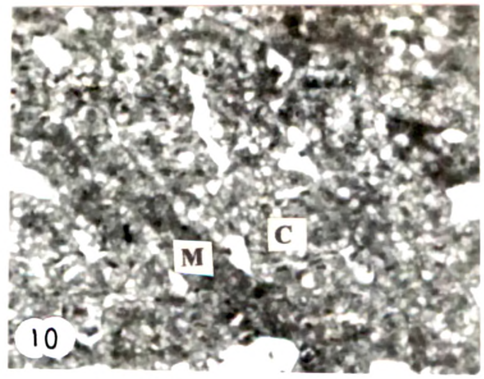
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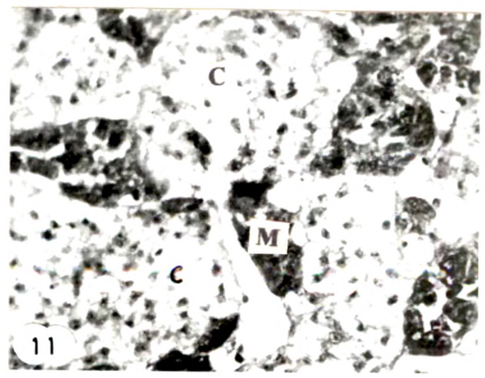
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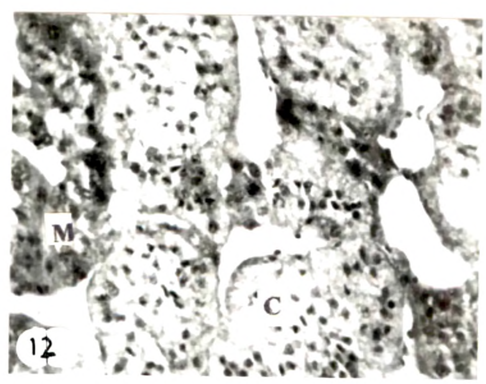
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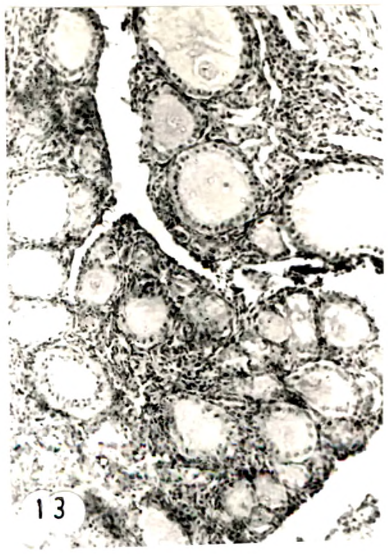
Plate 3 (Figs. 13-16)

Photomicrographs of 30 day old ovary of NLD (control) and LP chicks (160 and 320 x)

Figs. 13-14. Ovary of 30 day old control chick showing many primary and primordial follicles.

Figs. 15-16. Ovary of control chick showing many primary and primordial follicles with hypertrophied granulosa (Gr). Note the thecal condensation around larger follicles.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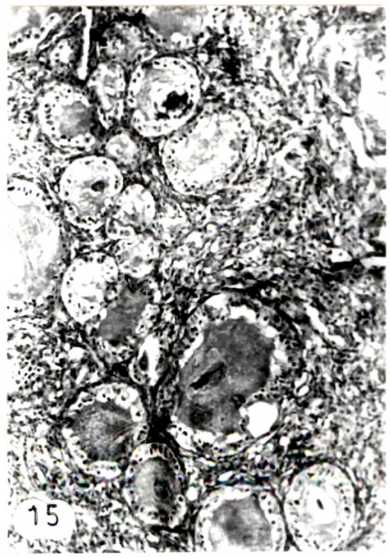
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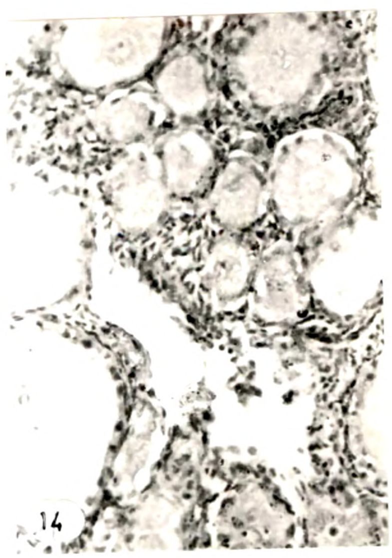
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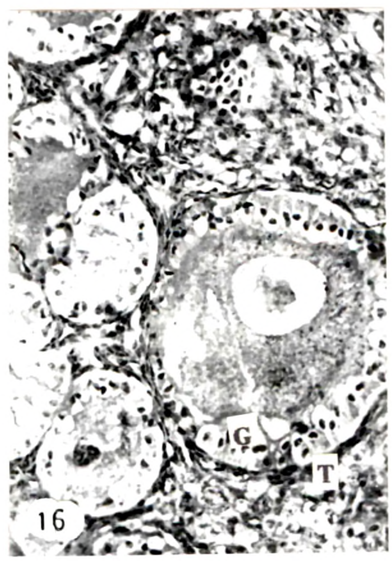
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Plate 4 (Figs. 17-20)

Photomicrographs of 60 day old ovary of NLD (control) and LP chicks (160 and 320 x).

Figs. 17-18 (a-b). Ovary of control chick showing small medium (fig. 27,28a) and large (fig. 28b) follicles with prominent granulosa. Note the hypertrophied stroma and condensed theca.

Figs. 19-20. Ovary of control chick showing prominent and active theca(Th) surrounding large follicles. Some follicles are atretic. (Af)


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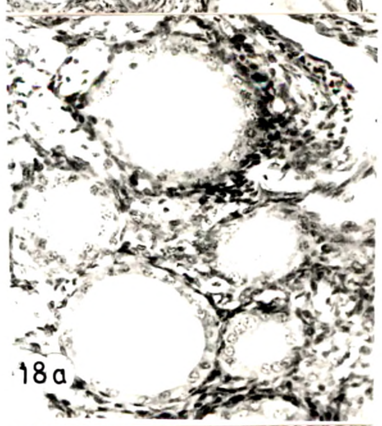
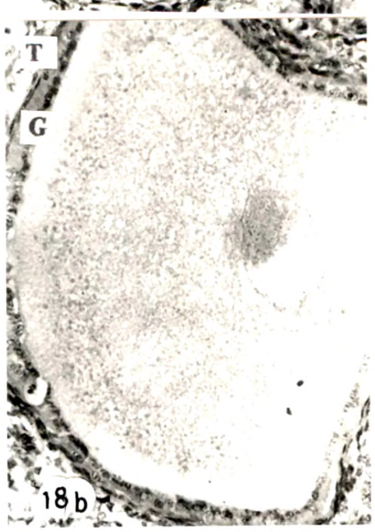

18a


T
G
18b


AF
19

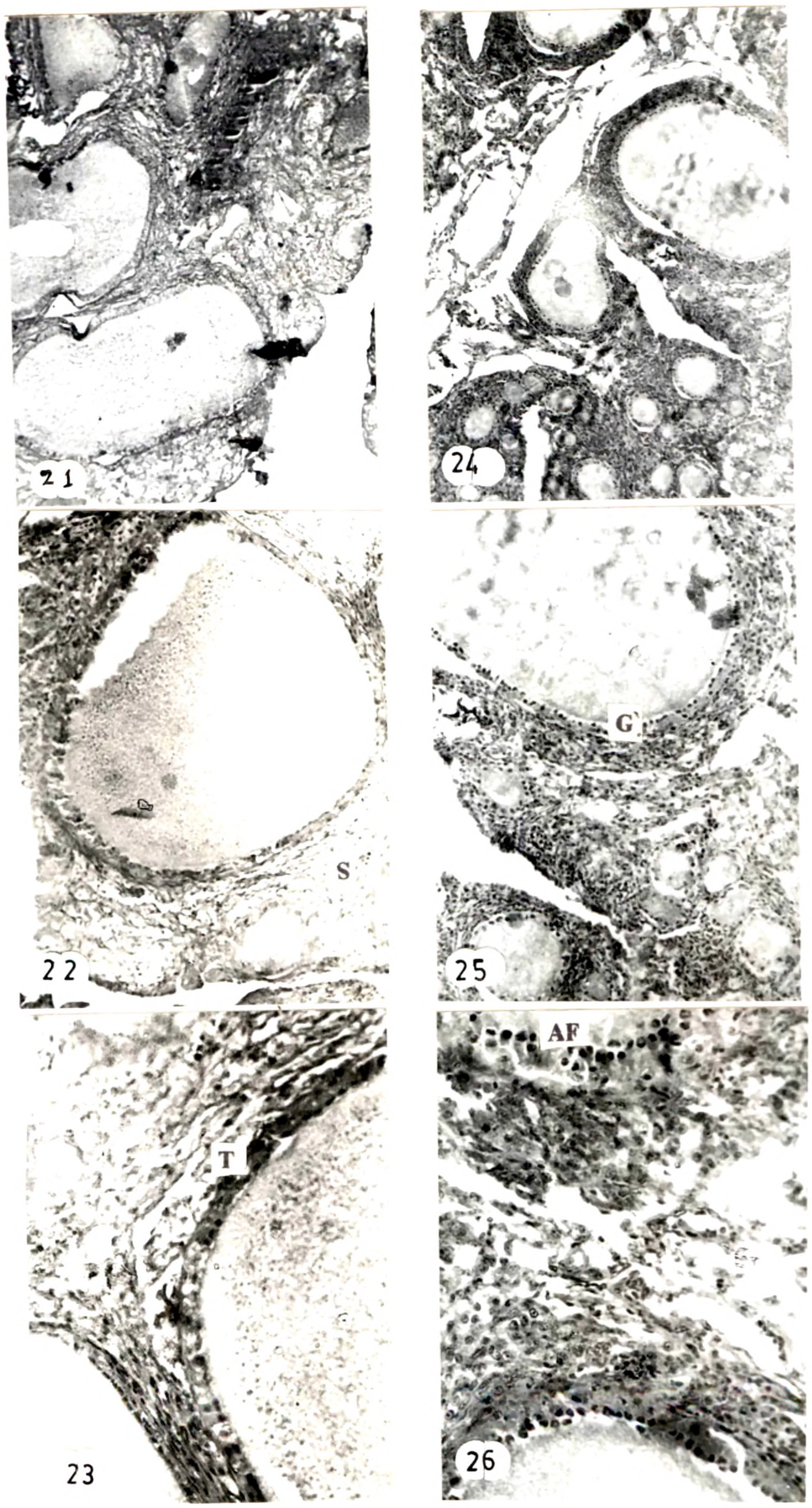

T
G
20

Plate 5 (Figs. 21-24)

Photomicrographs of 90 day old ovary of NLD (control) and LP chicks (80, 160 and 320 x).

Figs. 21-23. Ovary of control chick showing overall less number of follicles. Theca thin and fibrous, stromal tissue appears loose.

Figs. 24-26. Ovary of control chick showing many medium to large sized follicles with prominent hypertrophied granulosa. Note the atretic changes in some follicles.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to be more in the ovary of LP chicks, the rate of progression of the follicles into the higher hierarchial classes summed to be very slow as the number of follicles of big and large sizes were less. The percentage of atretic follicles was more at 30 and 60 days but significantly less at 90 days in the case of LP ovary. Whereas the ovary of NLD chicks did not show the presence of 6-30 μm follicles at 90 days, the ovary of LP chicks showed the presence of such follicles in almost the same number as at 30 and 60 days. The number of follicles, of size less than 200μm, was more in LP ovary at 30 and 90 days but, at 60 days, it was significantly less.

Discussion:

In general, the growth rates and growth kinetics of various organs were reduced in LP chicks, except for the thyroid and ovary, which showed significant increment and, the body weight, which was marginally higher. Most noticable effect in this connection, is a significantly increased growth rate at 60 days and significantly reduced growth rate at 90 days. Since there are no reports regarding changes in body weight and growth rates of organs during the period of chronic exposure to LP, it is difficult to make any detailed comparative discussion on these aspects. The significant changes noticed at 60 and 90 days in the present study (increased growth rates of organs and body at 60 days and decreased growth rate of the same at 90 days) in LP chicks, seem to bear some correlation with the recorded alterations in the serum CORT level which was higher at 60 days and significantly lower at 90 days. The most significant effect of LP seems to be on thyroid and ovary, which showed significantly greater weights at the end of exposure to LP. Whereas the body weight and the weights of liver and lymphoid organs in general, showed almost identical weights to that of NLD chicks, the weights of adrenal and oviduct were significantly lower. Apparently, exposure to LP has differential effects on growth kinetics of various organs, probably suggesting the need for different optimal hormonal balances.

In genéral, the serum levels of T_3, T_4, CORT and progesterone tended to show a gradual decrement with age in NLD chicks, but in the case of LP chicks, except for serum T_4 level, the other hormones tended to show a differential change, marked by increased CORT level and decreased T_3 and progesterone levels at 60 days. A comparison between NLD and LP chicks reveals, relatively higher T_3 and T_4 levels throughout, and increased CORT level and decreased progesterone levels at 30 and 60 days in LP chicks. The clear correlation between CORT levels and body growth and growth of liver and lymphoid organs, suggest a favourable influence of CORT on growth of liver and lymphoid organs in the domestic fowl, as has also been inferred by some workers (Davison *et al.,* 1979; Siegel *et al.,* 1979; Davison *et al.,* 1985). Since both thyroid hormones and CORT have been implicated in growth kinetics, a cursory glance at the T_3 : CORT and T_4 : CORT ratios indicates lower ratios at 60 days and significantly greater ratios at 90 days in LP chicks, corresponding to the increased growth rates at 60 days and retarded growth rates at 90 days. Obviously, supra optimal ranges of T_3 : CORT and T_4 : CORT ratios are unfavourable for growth while, optimum ranges of these ratios are favourable (Table 6). Apparently, the present results suggest that the growth of the body and growth rates of various organs are not related to the absolute levels of thyroid and adrenal hormones but to optimal ranges of the same.

The data on thyroid and adrenal indicate a differential effect of LP with peak growth rates for thyroid at 60 and 90 days and for adrenal at 60 days with consequent increased absolute and relative weights of thyroid and decreased absolute and relative weights of adrenal at the end of 90 days. Interestingly, the thyroid showed a lower growth rate and weight at the end of (0-30 days) 30 days, while adrenal showed significantly lower growth rate at 60 and 90 days. Long photoperiod seems to have an initial depressive effect on thyroid growth and stimulatory effect thereafter. Persistent LP seems to have depressive effect on adrenal growth in the later phases, though initially favourable. The hypothalamo-hypophyseal thyroid (HHT) axis seems to be stimulated by LP, as revealed by the higher absolute T_3 and T_4 levels, as well as the higher ratios of T_3/T_4 : body weight and T_3/T_4 : thyroid weight, implying increased thyroid output. The inhibitory effect of prolonged LP on hypothalamo-hypophyseal adrenal (HHA), axis is not only indicated by the lower CORT level but, also by the lowered CORT :body weight or adrenal weight ratios. The histological features of these two glands also corroborate well with the above inferences. Previous studies on photoperiodism, sexual maturation and egg laying, had highlighted the importance of exposure to a short photoperiod (SP) prior to exposure to LP, for the stimulatory response of photoperiod on the HHG axis (see Etches, 1996). A hypothesis put forth by integrating the various available experimental evidences, has suggested the hypothalamic GnRH neurons to be sensitive to both short and long photoperiods in the form of inhibitory and stimulatory inputs respectively (Sharp, 1993). However, photosensitivity of juvenile birds has not been studied in greater detail (Etches, 1996). The HHG axis seems to be stimulated under exposure to LP, which is well reflected in the weight, histological features and histometrics of the ovary. In this context, the present study evaluates the effect of continuous exposure to LP from the day of hatch till 90 days of age. Though it is not possible to specifically identify the exact phase of photosensitivity from the time of hatch, the present observations definitely suggest stimulatory effects of LP during 1-90 days of age. The histometric studies of the ovary reflect the stimulatory influence of light at 30 days itself, as indicated by the increased number of follicles by 23%. The stimulatory influence of LP is also indicated by the higher rate of transition of follicles from small to big and big to large size ranges at 60 and 90 days. Another aspect of differential effect of LP, as against NLD, is the quantum of follicular atresia from 1 to 90 days, which decreases from 24% to 4.5% in LP chicks, as against an increase from 3.3% to 30.8% in NLD chicks. There is also an apparent increase in the number of small follicles throughout in LP chicks, which is well reflected in the presence of small follicles of 6-30 µm in sizable numbers as contrasted with the total absence of such follicles in the ovary of NLD chicks. The increased number of follicles and, reducing rate of atresia, attest to a stimulatory influence of photoperiod, in first 90 days of age. However, LP chicks were recorded to lay significantly less number of eggs than NLD chicks (see Chapter 2). This could be speculated to be due to, the probable higher incidence of follicular atresia consequent to exposure to a shorter photoperiod at the end of 90 days (step-down photoschedule). Androgens have been implicated in follicular atresia in mammals (Harvey *et al.*, 1978; Scanes *et al.*, 1981; Harvey *et al.,* 1983; Kameda *et al.,* 1984; Scanes *et al.,* 1984; Huybrechts *et al.*, 1985; Thedoropoulous, 1985; Kuhn *et al.*, 1986) and, in this respect, it can be speculated that there is decreased androgen production in the ovary of LP pullets. This is substantiated by the herein observed relatively higher levels of serum progesterone at 60 and 90 days.

Despite the observed stimulatory effects in the ovary of LP chicks, sexual maturity was delayed and, the total number eggs laid was less, subsequent to exposure of the pullets to NLD schedule (see Chapter 2). Continuous exposure to LP seems to induce photorefractoriness between 60 and 90 days, as can be gauged by the growth rate and growth index of the ovary, which are both significantly reduced and, also by the percentage decrease of big and large follicles relative to the second month (Sharp, 1993; Etches, 1996). A step-down photoperiod from 90 days apparently strengthens the inhibitory component . Explicably, the HHG axis is set back and, gradually restarted in the new photoschedule which probably explains the delayed onset of sexual maturity (see Chapter 1). It may also be speculated that, the sudden arrest in ovarian development due to switch to relatively short photoperiod, could result in increased follicular loss and ultimately in re-initiation of development. The available pool of follicles is depressed resulting in decreased oviposition as reported earlier (Dandekar,1998). These concepts however need to be ascertained. Overall, it can be concluded from the present observations that, exposure of freshly hatched pullets from 1-90 days, has differential effects on growth kinetics and, a definite favourable influence on HHG axis suggesting inherent photosensitivity and, no settling in of photorefractoriness during this period