CHAPTER 2

INFLUENCE OF TRANSIENT HYPO./HYPERCORTICALISM IN PULLETS ON EGG LAYING PERFORMANCE OF DOMESTIC FOWL (RIR breed).

A quantitative trait like egg productivity in poultry birds is the consequence of the sum total of interactions between genetic and epigenetic factors. The genetic factor is the genotype of the breed and, the potential of the trait determined by it, is often modified by the influence of epigenetic factors represented by the environmental variables. Apparently, the productivity potential of a particular breed of domestic hen can be altered by the prevailing environmental conditions and a change in even one environmental variable can have a consequent effect on the trait. As such, research on poultry productivity over the years has revealed seasonal variations (Hall and Marble, 1932; Rahm, 1976; Charles, 1984; Okumura *et al.,* 1988; Sharp, 1993). Moreover, many experimental evaluations have shown the independent influence of various factors like humidity, temperature, management practices and most importantly, nutrition and photic schedules (Dunn *et al.,* 1990; Lewis *et al.,* 1996a,b; Sandoval and Gernet, 1996).

The ultimate evocator of sexual maturity and reproductive functions are the endocrine secretions, and the various environmental factors serve as proximate factors and thereby modulate reproductive functions (Murton, 1978). Photoperiod as an environmental variable, is known to have its primary influence on the neuroendocrine axis controlling reproduction, which involves the hypothalamus, pituitary (hypophysis) and gonads and classically referred to as the HPG/HHG axis. In poultry birds, like in other birds and vertebrates, light is shown to control ovarian functions through hypothalamic modulation of pituitary gonadotrophin secretion (see Etches, 1996). Though gonadotrophic hormones are considered classical hormones of reproduction, the influence of non-classical hormones like the adrenal steroids and the thyroid hormones is getting clearly established by the recent studies in mammals (Kalland *et al.*, 1978; Pankakoshi *et al.*, 1982; Francavilla, *et al.*, 1991; Joyce *et al.*, 1993; Palmero *et al.*, 1989, 1992, 1993; de Krester *et al.*,1995). The interrelationships between the gonads and the thyroid or adrenal glands have been studied in adult avian species and based on the findings, both parallel and inverse relationships have been inferred. In this respect some workers showed parallel adrenal-gonadal (Patel *et al.*, 1986; Ramachandran and Patel, 1986; Ramachandran *et al.*, 1987; Ayyar *et al.*, 1992) and others an inverse adrenal-gonad (Riddle *et al.*, 1924; Legait and Legait, 1959; Fromme-Bouman, 1962; Ramachandran and Patel,1988) relationships. Similarly, both parallel and inverse thyroid-gonad relationship have also been reported (Thapliyal and Pandha, 1967a,b; Jallageas and Assenmacher, 1973, 1974; Oshi and Konishi, 1978; Patel *et al.*, 1985; Ramachandran and Patel, 1986; Ramachandran *et al.*, 1987). These works though showing differential relationships, probably valid when considered on the basis on feral V/s domestic species, were however all carried out in the adult birds. Pertinently, there are some studies suggesting some as yet unexplained influence of adrenal and thyroid hormones on ovarian functions and egg laying in poultry birds (Singh and Parshad, 1978; Wilson and Cunningham, 1980; Lang *et al.,* 1989). The influence of these hormones has been studied in domestic birds in greater detail with relation to growth and metabolism (Blivaiss, 1947; Winchester and Davis, 1952; Nagra and Meyer 1963; Nagra *et al.,* 1965; Raheja *et al.,* 1971; King and King, 1973; Kallicharan and Hall, 1974; Carasia,1987; Bartov, 1982; Kuhn *et al.,* 1984; Akiba *et al.,* 1992; Hayashi *et al.,* 1994).

Since most of the studies with reference to thyroid and adrenal hormones are carried out in adult poultry birds and only a few of them infact in relation to reproductive function, there is a clear lacuna in terms of studies involving these endocrine glands in immature birds. A preliminary work initiated on this line from this laboratory involving experimental induction of hypercorticalism/hypocorticalism between 1- 30d in White Leghorn chicks had revealed a retardatory influence of corticosterone on growth and differentiation of testes (Joseph and Ramachandran,1993).

It becomes clear from the above work, that the non-classical hormones have some effects on reproductive functions and, part of their influence on sexual maturity and adult reproductive functions may be exerted at a crucial window during the sexually immature growth phase, as being revealed from studies on mammals (Palmero *et al.,* 1989, 1992, 1993; de Krester *et al.,*1995). Moreover, the photoperiodic response on sexual maturity and laying performance in domestic hen has been primarily shown to be age dependent (Gutteride and O'Neil, 1942; Hutchinson and Taylor, 1957; Dunn and Sharp, 1992; Lewis *et al.,* 1992; Lewis *et al.,* 1994; Lewis *et al.,* 1996a,b) and restricted to the 1st 90 days. By the many past studies in the temperate countries (Hutichinson and Taylor. 1957; Morris, 1963;

Lewis *et al.,* 1992) and the recent studies from this laboratory under tropical conditions (Chapter I; Devkar, 1998) formed the rationale for the present study to test the influence of mild hypercorticalism(HPR) or hypocorticalism (HPO) induced upto 90 days in RIR pullets on attainment of sexual maturity and various features of laying performance thereafter. Further, the study was also extended to adult birds towards the end of laying for assessing the performance of 2^{nd} cycle of lay.

RESULTS

Set-up I :

Body weight and duration of egg laying :

Growth of pullets as indicated by the changes in body weight (table I; fig. 1) showed a retardatory influence of hypercorticalism and, the body weight was lesser than the controls throughout, though statistically insignificant. Hypocorticalism tended to increase the body weight as the pullets showed higher body weight throughout except at 60 and 90 days, when it was significantly lower. At the end of 30 and 180 days, the body weight of HPO pullets was significantly greater. Initiation of egg laying (IL) or age at first egg occurred almost at the same time in all the groups though the HPR birds showed an earlier commencement by an average of two days, while the HPO birds showed a marginal delay by an average of two days. The termination of egg laying occurred four days later in HPR birds and 4 days earlier in HPO birds. This contributed to a slightly increased effective period of laying in the HPR birds by six days and a slightly shorter effective period of lay in HPO birds by again six days (table 2; fig.2 A - C). However, these changes were statistically insignificant.

Number and weight of eggs and rate of lay :

As against a total lay of 168 eggs/hen by the control birds, the HPR birds did not show any significant difference (171 eggs/hen), while the HPO birds laid significantly lesser number of eggs (156 eggs/hen). However, the effective number of eggs represented by average sized eggs weighing 40 gms or above was lesser in HPO birds by only 6 eggs/hen as the percentage of small eggs (<40 gms) laid by the HPO hens was lesser than the control and HPR birds. The overall rate of lay was 0.46 eggs/day with an average oviposition interval of 50 hrs in both control and HPR hens and 0.45 eggs/day with a mean oviposition interval of 53 hrs in HPO hens. The average weight of eggs laid by these group of birds was 46.59 gms in control, 45.42 gms in HPR and 46.20 gms in HPO hens (tables 3 & 4; fig 3 A - C).

Monthly variations in the first lay :

The average monthly egg yield was maximum during the second and fourth months of lay in both control and HPR hens (66.7% Vs 65% and 60.8% Vs 60% respectively). In the HPO hens the maximal yields occurred during the third, fourth and fifth months represented by 61.7%, 61.8% and 60% respectively. Except for the third, sixth, eleventh and twelfth months, when the HPR hens laid marginally more number of eggs, on the other months the egg yield was marginally lower. A pattern of fluctuating yield during the first four months shown by both the control and HPR hens in the form of increase in the second month, decrease in the third month and again increase in the fourth month was not manifested by the HPO hens and these hens depicted a gradually increasing steady egg yield till five months. The average monthly egg yield was significantly greater in the HPO birds between the third and seventh months. However, the decrease in the egg yield was more drastic and precipitous during the last four months. The data on these aspects is represented in table 5; fig. 4.

The average monthly clutch size remained below two in HPO hens while clutch size of more than two was recorded in the control (second and fifth months) and HPR (second and fourth months) hens, more significant in the former (table 6). The monthly average number of clutches was ten or more only during the seventh and eighth months in control birds compared to between first and eighth and fifth and eleventh months in HPR hens. The HPO hens continuously yielded more than ten clutches except during the last three months when the egg yield was precipitously low. These changes are shown in table 7 and fig. 5a. The average number of clutches of various sizes during the laying period presented in table 8; fig.5b, shows a maximum clutch size of 3, 4 and 5 in the HPO, HPR and control hens respectively.

The data on monthly rate of lay depicted in table 9, shows that the maximum rate of lay in NLD hens was 0.66 and 0.61 eggs/hen/day at an egg interval of 36 hrs and 39 hrs respectively during the second and fourth 7months, while the same in HPR hens was 0.65 and 0.60 eggs/hen/day at an interval of 37 hrs and 40 hrs respectively during the same months. The HPO hens laid at a rate of 0.59 to 0.61 eggs/hen/day with an egg interval of 41 to 39 hrs between second and fifth months. The overall minimal to maximal variation in mean monthly egg weight and the overall average egg weight were more or less same in all the three groups of hens.

Set-up II :

The data on the second cycle lay of hens subjected to HPR or HPO between 72 and 76 weeks of age and that of the control hens is

Table: 1 Body weight gain upto 180 days in hypercorticalic (HPR) and hypocorticalic (HPO) pullets under **NLD**.

	30 days	60 days	90 days	120 days	150 days	180 days
HPR	103.84 ±12.85	254.44 ±22.27	590.00 ±29.55	841.21 ±20.36	1007.30 ±26.13	1102.55 ±23.61
Control	117.20 ±16.33	312.85^{a} ±18.22	600.0 ±16.32	852.80 ±20.80	1020.80 ±23.65	1140.20 ±25.43
HPO	150.00 ±11.54	380.62^{b} ±23.0	533.33^{b} ±12.47	863.82 ±26.41	1048.34 ±16.37	1201.77^{a} ±19.37

Values : Mean ± SE, n=12 , ^{a} P<.05, ^{b}P<.005.

Table :2 Age at which initiation and termination of egg laying occured in hypercorticalic (HPR) and hypocorticalic (HPO) pullets under **NLD**.

	Initiation	Termination	Effective days of lay
HPR	176.18 ± 1.07	534.15 ± 0.92	358.44 ± 1.79^{a}
Control	178.27 ± 1.24	530.63 ± 1.66	352.36 ± 1.36
HPO	180.09 ± 1.06	526.26 ± 1.37^{a}	346.95 ± 1.05^{b}

Values : Mean ± SE, n=12 , ^{a} P<.05, ^{b}P<.005.

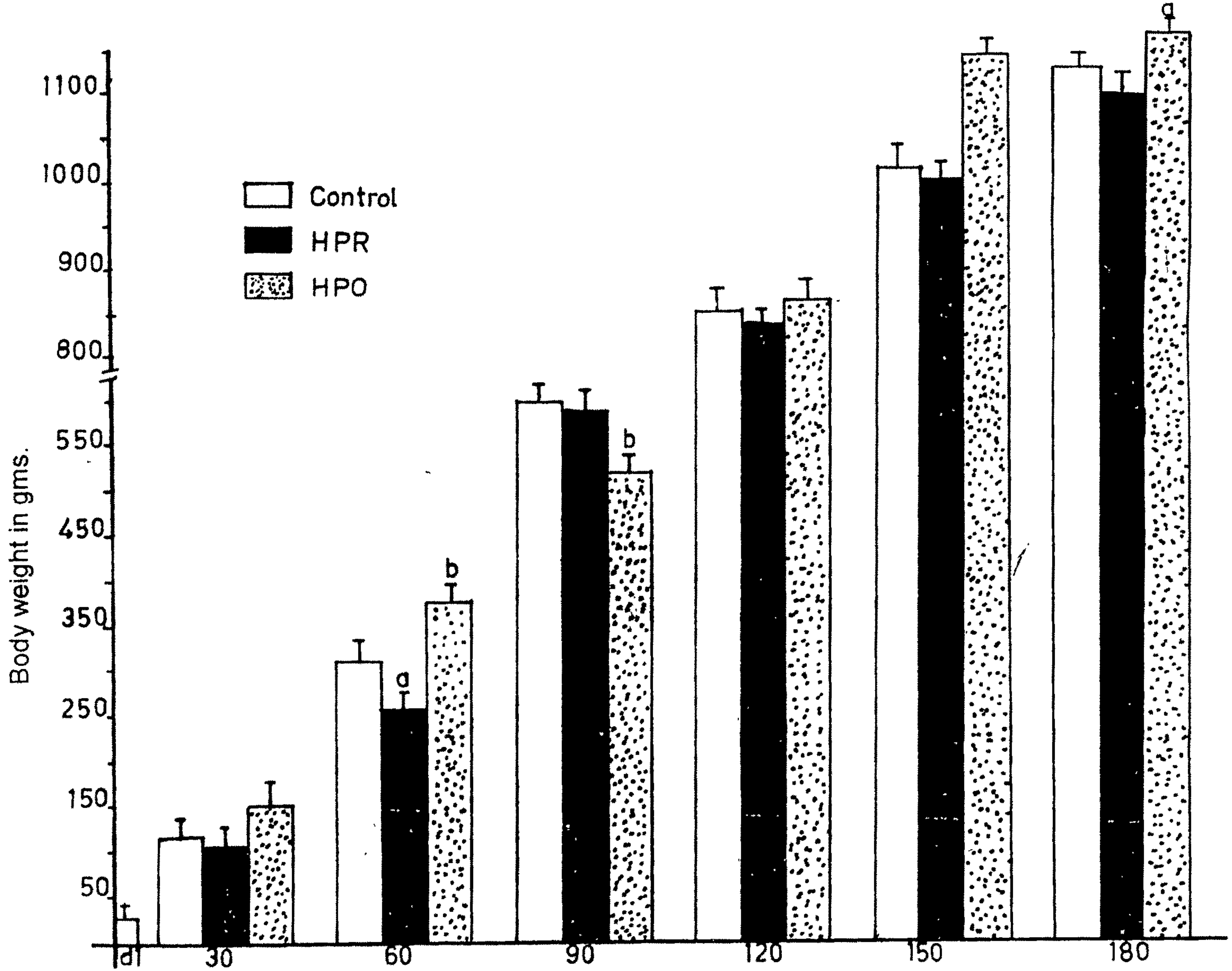

Fig.1 Body weight gain in Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under NLD. Values · Mean, ±S.E, N= 12 **[a]$P < .05$, [b]$P < .005$.** NLD - LD 12:12

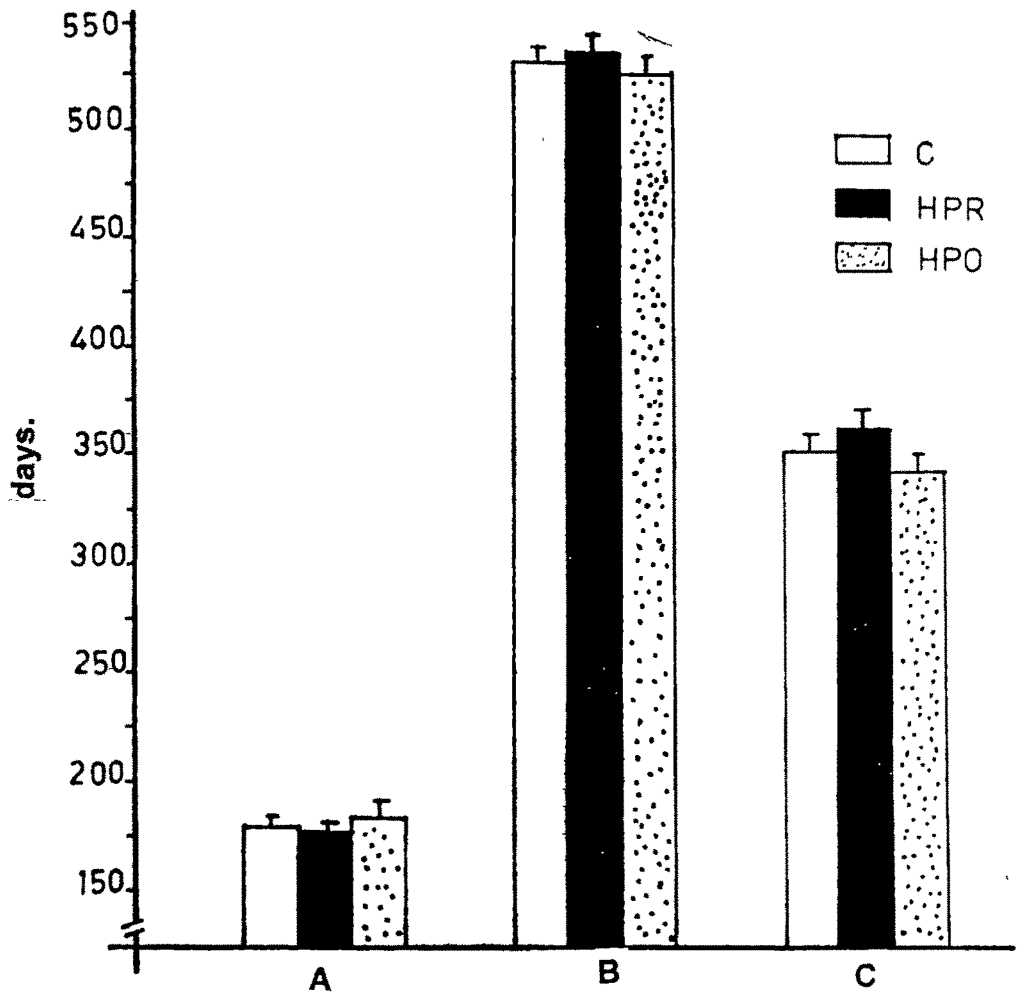

Fig.2 Figure showing age at initiation (A), termination (B) and effective number of days of lay of Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under NLD.
Values : Mean, ±S.E, N= 12 NLD - LD 12:12

Table:3 Laying performance of first lay in hypercorticalic (HPR) and hypocorticalic (HPO) pullets under **NLD**.

	Total number of eggs/hen	Total number of small eggs/hen		Total no.of effective eggs/hen	rate of lay	
		number of eggs	%		eggs/day	mean oviposition interval in hrs
HPR	171.35 ± 2.63	14.5 ± 1.37	8.2	157.04 ± 2.37	0.47	50.06
Control	168.82 ± 3.76	16.25 ± 2.43	9.5	152.22 ± 2.86	0.47	50.13
HPO	156.59 ± 3.29[a]	10.0 ± 1.68[a]	6.4	146.37 ± 2.66	0.45	53.0

Values : Mean ± SE, n=12 ,[a] $P<.05$

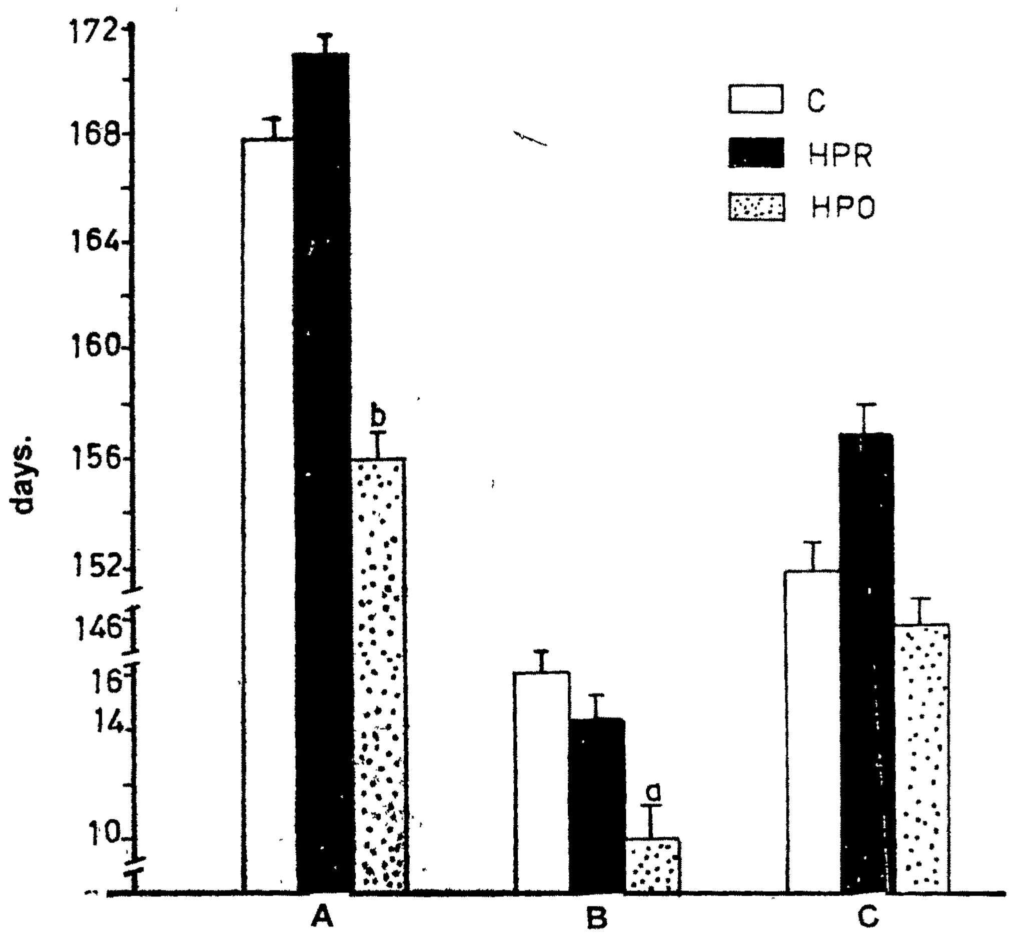

Fig. 3 Figure showing egg laying performance of Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under NLD.

A) Total no. of eggs per hen (hen day production), **B)** Total no. of small eggs and **C)** Total no. of effective eggs.

Values : Mean, ±S.E, N= 12   NLD - LD 12:12

Table:4 Average monthly egg weight in hypercorticalic (HPR) and hypocorticalic (HPO) pullets under **NLD**.

Period of lay in months	Average monthly egg weight		
	HPR	*Control*	*HPO*
1	40.3 ± 2.3	42.2 ± 3.37	43.01 ± 2.13
2	42.9 ± 4.3	44.46 ± 5.41	42.13 ± 4.52
3	44.37 ± 3.97	44.92 ±3.41	43.23 ± 3.21
4	45.42 ± 4.01	44.08 ± 3.84	45.65 ± 3.11
5	45.18 ± 5.13	44.16 ± 4.42	44.39 ± 3.73
6	47.09 ± 4.18	46.18 ± 7.69	46.18 ± 2.81
7	45.63 ± 2.97	45.48 ± 3.90	46.91 ± 2.67
8	44.16 ± 4.13	45.90 ± 3.96	45.23 ± 3.14
9	45.9 ± 4.23	45.28 ± 5.28	46.71 ± 2.76
10	45.3 ± 1.3	45.90 ± 2.53	48.3 ± 3.61
11	46.43 ± 2.11	45.66 ± 2.54	48.17 ± 1.83
12	49.73 ± 2.76	48.06 ± 2.65	48.66 ± 1.57
Average egg weight	45.62 ± 4.39	46.59 ± 5.11	46.23 ± 4.69

Values : Mean ± SE, n=12.

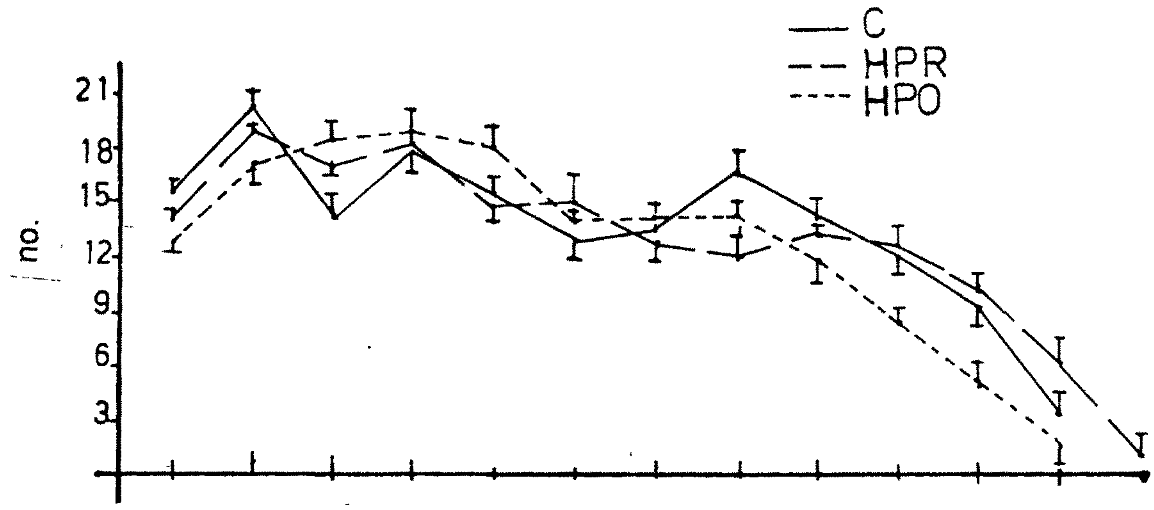

Fig. 4 Figure showing average monthly egg production of Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under NLD.

Values : Mean, ±S.E, N= 12 C - Control (NLD), NLD - LD 12:12

Table:5 Average total number of eggs of hypercorticalic (HPR) and hypocorticalic (HPO) birds under **NLD**.

	1	2	3	4	5	6	7	8	9	10	11	12
HPR	14.5 ±2.38	19.5 ±1.21	17.0 ±.81	18.0 ±2.70	15.75 ±1.71	15.0 ±1.20	13.0 ±.81	12.75 ±1.5	13.75 ±2.06	12.75 ±.95	10.5 ±1.73	6.75^{b} ±3.86
C	15.55 ±1.29	20.0 ±0.81	14.75 ±.35	18.25 ±1.70	16.00 ±.83	13.25 ±1.25	13.75 ±.95	15.20 ±2.06	14.00 ±1.40	12.5 ±.57	9.57 ±.50	3.25 ±.53
HPO	13.5 ±.81	17.75^{b} ±.52	18.5^{c} ±.55	18.53 ±1.01	18.0 ±.57	14.52 ±.24	14.03 ±.43	14.75 ±.77	12.27 ±.57	7.78^{a} ±.25	4.25^{c} ±.50	2.52^{c} ±.57

Values : Mean ± SE, n=12 , ^{a} P<.05, ^{b}P<.005,^{c}P<.0005.

Table: 6 Average monthly clutch size of hypercorticalic (HPR) and hypocorticalic (HPO) birds under **NLD**.

	1	2	3	4	5	6	7	8	9	10	11	12
HPR	1.26^{a} ±.15	2.29^{a} ±.19	2.06 ±.21	2.11 ±.38	1.34^{a} ±.24	1.42 ±.13	1.15 ±.20	1.27 ±.34	1.12 ±.41	1.13 ±.57	1.02 ±.09	0.79 ±.06
C	1.93 ±.16	3.07 ±.34	2.18 ±.21	2.60 ±.24	2.37 ±.10	1.80 ±.24	1.36 ±.04	1.39 ±.27	1.52 ±.24	1.56 ±.12	1.11 ±.13	1.0 ±.006
HPO	1.22^{b} ±.03	1.54^{c} ±.06	1.64^{a} ±.03	1.60^{c} ±.05	1.61 ±.05	1.23^{a} ±.04	1.10^{a} ±.08	1.13 ±.06	1.11^{a} ±.07	1.03 ±.07	1.00 ±.01	1.00 ±.01

Values : Mean ± SE, n=12 ,^{a} P<.05, ^{b}P<.005,^{c}P<.0005.

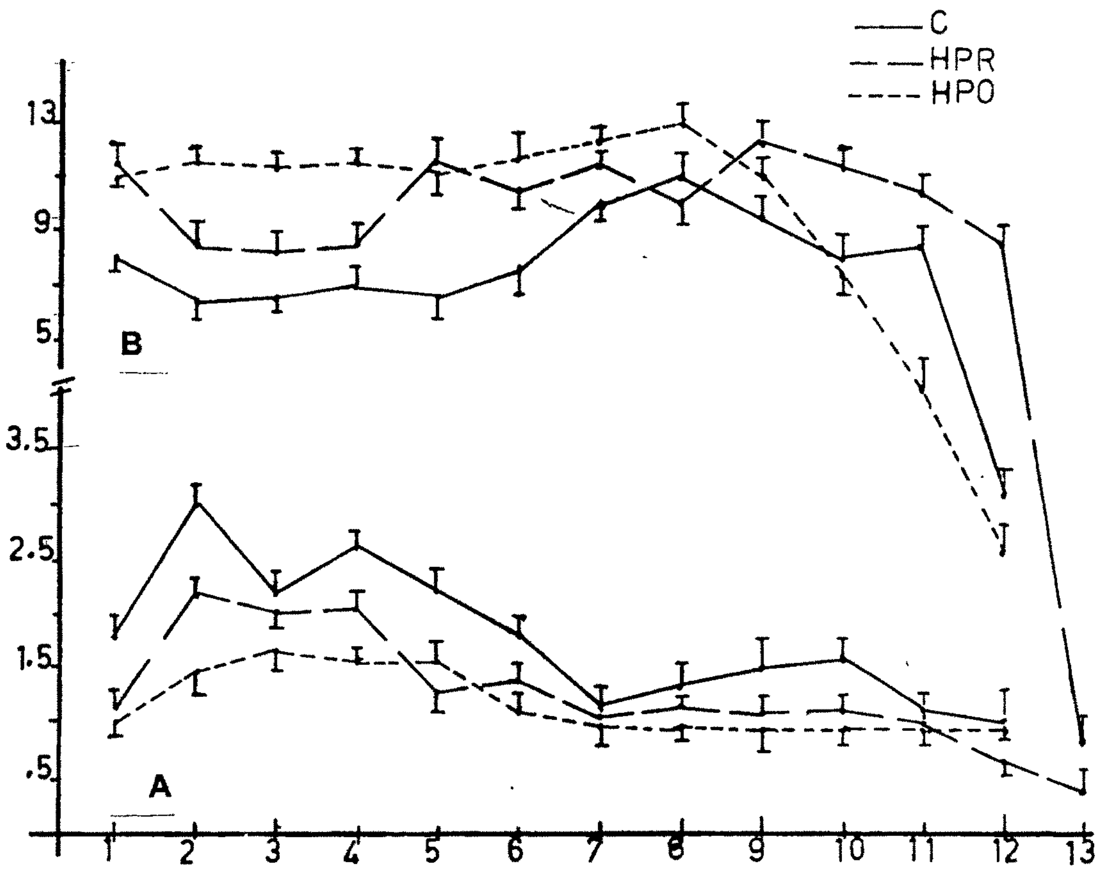

Fig. 5 A & B. Figures showing monthly average clutch size (A); and average number of clutches (B) in Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under NLD.

C - Control. Values : Mean, ±S.E, N= 12

Table: 7 Average number of clutches per month in hypercorticalic (HPR) and hypocorticalic (HPO) birds under **NLD**.

	1	2	3	4	5	6	7	8	9	10	11	12
HPR	11.5^a ±1.29	8.5^a ±1.30	8.25^a ±.95	8.56 ±.57	11.75^c ±1.25	10.5^a ±1.29	11.25 ±.95	10.0 ±1.15	12.25^a ±.95	11.35^a ±.50	10.25 ±.98	8.5^c ±1.29
C	8.0 ±0.69	6.5 ±.57	6.75 ±.50	7.0 ±.80	6.75 ±.50	7.25 ±.50	10.0 ±.81	11.0 ±.81	9.25 ±.95	8.00 ±.81	8.75 ±.95	3.25 ±.50
HPO	11.0^a ±.81	11.5^b ±1.29	11.25^b ±.95	11.5^b ±.57	11.25^c ±.92	11.75^a ±.98	12.25 ±.97	13.0 ±1.82	11.0 ±1.15	7.75 ±.52	4.26^c ±.53	2.56^c ±.57

Values : Mean ± SE, n=12 , ^{a} P<.05, ^{b}P<.005, ^{c}P<.0005.

Table:8 Number of clutches of various sizes of hypercorticalic (HPR) and hypocorticalic (HPO) birds under NLD.

	1 month			2 months			3 months			4 months			5 months			6 months		
	HPR	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*
1	9.25^{b} ±1.5	3.5 ±1.29	10.3^{c} ±1.15	2.01 ±.41	1.25 ±.95	6.25^{b} ±2.06	3.5^{a} ±.95	1.75 ±.50	5.75^{c} ±.50	2.75^{c} ±.58	0.25 ±.05	5.00^{c} ±.81	8.01^{c} ±1.15	3.0 ±1.82	7.00^{b} ±1.82	7.75^{b} ±1.20	6.5 ±1.29	8.7^{b} ±.67
2	1.50 ±.57	1.75 ±.50	1.00 ±.22	3.75^{b} ±.95	1.00 ±.21	3.75^{b} ±1.50	3.25^{a} ±.50	1.78 ±.50	3.77^{a} ±.95	2.75 ±.95	3.75 ±.50	5.25 ±1.50	3.50 ±1.29	3.50 ±1.29	2.75 ±.79	2.25 ±.95	2.25 ±1.25	2.53 ±.35
3	0.75 ±.25	2.00 ±.81	0.75 ±.03	3.06 ±.41	1.75 ±.75	1.50 ±.55	1.03 ±.29	1.83 ±.80	1.75 ±.47	3.08 ±.56	2.25 ±.78	1.25 ±.38	0.25 ±.07	2.16 ±1.5	1.15 ±1.00	0.50^{b} ±.006	1.25 ±.30	.59^{b} ±.03
4	--	0.50 ±.18	--	0.25^{c} ±.02	2.25 ±.50	--	0.50^{c} ±.07	1.00 ±.09	--	--	0.50 ±.13	--	--	0.50 ±.08	--	--	0.50 ±.11	--
5	--	--	--	--	1.25 ±.22	--	--	--	--	--	--	--	--	--	--	--	--	--

	7 months			8 months			9 months			10 months			11 months			12 months		
	HPR	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*
1	9.75^{a} ±.95	6.50 ±1.29	10.5 ±1.08	7.25 ±1.70	6.50 ±2.38	11.23 ±1.71	11.0^{b} ±1.41	4.25 ±2.21	10.3^{b} ±1.47	10.2^{c} ±.51	4.0 ±1.15	6.79 ±.53	10.35 ±.70	8.25 ±1.50	4.21^{c} ±.47	8.5^{b} ±1.29	3.00 ±.81	2.52 ±.37
2	1.5 ±.57	2.75 ±.50	1.75 ±.83	2.75 ±.98	3.75 ±1.50	1.79 ±.76	1.25^{b} ±.75	4.75 ±1.25	1.11^{b} ±.08	1.00 ±.07	4.25 ±.50	0.78 ±.32	--	0.75 ±.15	--	--	--	--
3	--	0.50 ±.05	--	--	0.25 ±.10	--	--	0.25 ±.01	--	--	--	--	--	--	--	--	--	--

Values : Mean ± SE, n=12 , ^{a} P<.05, ^{b}P<.005, ^{c}P<.0005.

Table:9 Average monthly rate of egg laying in hypercorticalic (HPR) and hypocorticalic (HPO) birds under **NLD.**

	eggs/day			**mean oviposition interval (in hrs)**		
	HPR	***C***	***HPO***	***HPR***	***C***	***HPO***
1	0.48	0.51	0.45	49.4	46.3	53.2
2	0.65	0.66	0.59	36.7	36.0	40.5
3	0.56	0.49	0.61	42.2	48.7	38.8
4	0.60	0.60	0.61	39.8	39.3	38.6
5	0.52	0.53	0.60	47.5	44.8	39.8
6	0.50	0.44	0.48	48.0	54.2	49.4
7	0.43	0.45	0.46	55.2	52.3	51.1
8	0.42	0.51	0.49	56.4	47.2	48.7
9	0.45	0.46	0.40	52.3	51.3	58.5
10	0.42	0.41	0.25	56.4	57.6	92.4
11	0.35	0.31	0.14	68.4	75.1	169.2
12	0.22	0.10	0.08	106.5	221.5	285.6

Values : Mean

Table:10 Second cycle laying performance of hypercorticalic (HPR) and hypocorticalic (HPO) birds under **NLD**.

	Av. total number of eggs laid/bird	Av. egg weight in gms	Average period of lay	Overall rate of lay/bird/month
HPR	110.56 ± 3.70[a]	49.30 ±2.18	11 months	10
C	96.02 ± 3.57	48.79 ±.040	11 months	8.7
HPO	75.95 ± 2.85[b]	48.36 ±3.13	11 months	6.81

Values : Mean ± SE, n=12 ,[a] P<.05, [b]P<.005.

Table:11 Comparative projection of total amount of feed consumed/bird till the end of lay and feed/dozen eggs

	Total no. of days	Total no. of eggs	Feed consumed (Kg/Doz. eggs)	Total feed consumed (kg.)
Govt. poultry record	530.00	178	4.28	63.50
HPR	534.83	171.54	3.62	51.86
C	530.63	168.47	3.65	51.18
HPO	526.49	156.27	3.91	50.9

Values : Mean

represented in table 8. As against 96 eggs laid by the NLD hens in 11 months at an average rate of 8.7 eggs/month, the HPR hens laid 110 eggs (15% more) at an overall rate of 10 eggs/month while, the HPO hens laid only 75 eggs (22% less) at a rate of 6.8 eggs/month (table 10).

DISCUSSION

From the results obtained, it becomes evident that induction of mild hyper. or hypocorticalism during the growing phase of pullets from day one to 90 has some influence on the egg laying performance. Though neither hyper. nor hypocorticalism showed significant difference on initiation of lay, the total number of eggs laid/hen during the first cycle showed a tendency for increment in the former while it was significantly less in the latter. The difference in the total yield of eggs between HPR and control birds on egg/hen basis though is insignificant, the cumulative difference in terms of a large flock of 100 or 1000 birds could nevertheless get magnified to be significant at more than 95% confidence level. Hypocorticalism on the other hand, significantly reduced the overall egg yield. The termination of lay occurred slightly later with a consequently increased effective number of days of lay in the HPR hens while, termination occurred earlier but with a lesser effective number of days of lay in the HPO hens. It is apparent from these observations that adrenocortical insufficiency in the growing phase could have an inhibitory influence on egg productivity in poultry birds. The overall rate of lay as well as the mean oviposition interval were both similar in control and HPR hens, while both showed a negative trend in the HPO birds. Interestingly, both the HPR and HPO groups of birds laid lesser number of small eggs, more significant in the case of latter, as compared to the controls. Due to this, their assessment in terms of the number of effective eggs further increased the difference between control and HPR birds while the difference between control and HPO birds got minimized.

The body weight of HPO hens was higher and that of HPR hens lower than, the control birds at the end of six months. These differences in the body weight are mainly due to an significantly lesser growth rate during the first two months in the case of HPR birds and due to an overall better growth rate in HPO birds, significantly greater during the first month and organ between the third and fourth month. Considering the monthly growth rate in HPO hens, the ultimate body weight could have been still higher but for decreased growth rate during the second and third months. Concurrently, the only phase of significantly greater growth rate in HPR hens was also manifested at this period. Apparently, the period between 60 and 90 days seems to be the most sensitive phase towards alterations in CORT level. The fact that, the maximum rate of diffusion of CORT or metyrapone from the implants occurs between 60 and 90 days (see table 3 as depicted in, material and methods) seems to emphasize the above. Studies involving CORT administration in chicks or hens have generally shown a retardatory influence of CORT (Baum and Meyer, 1960;Nagra and Meyer, 1963; Nagra *et al.,* 1963; Bellamy and Leonard, 1965; Gavora and Hodgson, 1970; Gavora and Kondra,1970; Sato and Glick, 1970; Magdi and Hutson, 1974; Gross *et al,* 1980; Williams *et al*, 1984; Saandoun, 1987; Brake *et al.,* 1988). The growth retarding influence of CORT as revealed by the above studies also finds favour in the presently observed overall decreased body weight in the HPR birds and the bettered body weight in the HPO birds. However, a consideration of the growth rate during the three months when the pullets were rendered HPR or HPO, reveals a maximal growth rate in the control and HPR pullets between 60 and 90 days and in the HPO pullets between 90 and 120 days. These periods of maximum growth may have some relation with the CORT and thyroid hormones. Growth promoting influence of thyroid hormones has been inferred by the many documented observations revealing severe growth retardation under HPO and its reversal by the provision of exogenous thyroid hormone (Blivaiss, 1947; Winchester and Davis, 1952; Raheja and Snedecor, 1970; Marks, 1971; Howarth and Marks, 1973; King and King, 1973). It is also shown that mild hyperthyroidism accelerates while severe hyperthyroidism depresses growth in chicks (Singh *et al,* 1968), suggesting the need for an optimum level of thyroid hormone for growth. The increased growth rates observed at different time periods in the HPR and HPO pullets in the present study do not seem to bear direct correlation with CORT and T_3 and T_4 levels and as such may have to be related with altered interactive hormonal levels and differential sensitivity as inferred in chapter 8.

A comparison of the various features of the first laying cycle reveals some subtle differences, though exhibiting an overall apparent similarity. One common feature is the period of 50% egg production, which occurs between 21 to 21.4 weeks in all the three groups. The data on average monthly yield shows a maximum productivity of 67% and 65% in the control and HPR hens respectively during the second month and 62% productivity during the 3rd and 4th months in HPO hens. Except for the first month which showed a slightly lesser lay, from the 2nd to 5th months, the HPO hens have depicted a steady high yield and infact the total number of eggs laid between the 3rd and 7th month was more than that laid by the control hens. Apparently, hypocorticalism in the pullet stage induces a uniform higher level of lay during the 1st eight months. However, the overall lower yield was mainly due to a precipitous steep decline in egg production during the last three months. In contrast, hypercorticalism during the pullet stage, induces a similar pattern of egg production as in the control hens during the 1st ten months. The marked reduction in egg yield which characterises the control birds during the last two months was not manifested in the HPR birds as they showed a gradual decline even during the last two months. It is this which has contributed to the slightly increased overall yield during the first lay. The average monthly clutch size was quite similar in the control and HPR hens except for a slightly larger size in the control hens during the first five months. The average number of clutches/month was also thereby similar in both control and HPR birds. However, the HPO birds showed a persistent steady clutch size varying between 1-1.6 only and a consequent higher average number of clutches/month except for the last three months when the number of clutches was very low. The data on the distribution of clutches of various sizes clearly shows that whereas the control hens laid clutches of 5 during the second month, the HPR birds laid maximum clutches of 4 only occasionally during the second and third months and the HPO hens never laid any clutch of 4 or 5 (Table 8). These observations suggest that the alterations in the circulating CORT level have some subtle influence on certain aspects of ovarian functions as related to the laying performance. Incidently, many studies in the adult hen have shown the importance of corticosterone in ovulation and its probable role in the induction of earlier secretion of progesterone from the mature follicle leading to LH surge (Etches and Cunningham, 1975; Beuving and Vonder,1977; Sharp and Beauing, 1978; Wilson and Lacassague, 1978;Williams and Sharp, 1978; Wilson and Cunningham, 1980; Beuving and Vonder, 1981; Johnson and van Tienhoven, 1983; Petitte and Etches, 1991; Etches 1996).

The data on feed consumption does not reveal any marked difference as the total feed consumption as well as the feed/dozen eggs were more or less the same in all the three groups. Apparently, the hypercorticalic or hypocorticalic state induced by schedules employed in the present study do not have any adverse effect on feed consumption (Table 11). Hence the tendency for qualitative differences in terms of ovarian functions indicated in the present study are essentially due to the altered adrenocortical status in the growth phase. Compared to the first laying cycle, the performance of the second cycle seems to be significantly altered when HPR or HPO was induced for one month towards the end of the first laying cycle. Clearly, over a 11 month laying period, the HPR hens laid 15% more eggs while the HPO hens laid 22% lesser eggs with a monthly rate of 10 to 6.8 eggs/hen respectively. Moreover, the average egg weight was also higher in the HPR hens. These observations suggest that even subtle alterations in the adrenal steroids have profound influence in the adult hens especially in relation to the second laying cycle. It is interesting to note that the few experimental attempts made to increase the egg yield of the second cycle are related to the induction of a transient state of stress and resultant ovarian atrophy following which there is increased ovarian regeneration and renewed robust laying cycle (Fraps, 1955; Hutchinson, 1962; Swans and Bell, 1974; Roland *et al.,* 1982; McDaniel, 1985; Donald and Carol, 1992). It is likely that the present experimental manipulation leading to chronic mild HPR or HPO and the observed effect on the laying performance may be related to a similar mechanism as in the above studies and, is a more ethical alternative than subjecting the hens to starvation.

Overall, the present study involving chronic hypercorticalism or hypocorticalism has provided some suggestive evidences for the influence of altered corticosterone levels both in the pullets and adult hens in relation to their 1st or 2nd laying cycle. Obviously, the present line of investigation has potential significance and as such needs to be studied in detail to decipher the optimal schedules in terms of age, dosage and duration.