CHAPTER 3

FURTHER FAVOURABLE INFLUENCE OF HPR BUT NOT OF HPO OVER A STEP-UP PHOTOPERIOD ON LAYING PERFORMANCE IN RIR BREED OF DOMESTIC FOWL.

Photoperiod as a factor of significance in poultry productivity became evident by the recognition of the ability of supplementary artificial lighting to stimulate egg production (Callenbach *et al.,* 1943; Morris,1968; Dunn and Sharp, 1992; Shanawany *et al.,* 1993a; Tucker and Charles, 1993). This was followed by the observation, that changes in the length of photoperiod during the rearing period have more consequential influence on the age at sexual maturity, egg weight and egg production (Eitan and Soller, 1991). Later, Hutichnson and Taylor (1957) correlated these influences on the reproductive potential of the domestic hen to the change in day length rather than to absolute day length. Absolute photoperiod is not the critical factor became evident by the observation that, hens became sexually mature roughly at the same time under a wide variety of lighting regimens (Lewis *et al.,* 1994). It was also inferred that, sensitivity to a change in photoperiod is not uniform for different photoperiods or ages as, photoperiodic manipulations made between 8 to 16h proved to be more effective than outside this range and changes made close to sexual maturity proved infructuious than changes made at younger ages (Morris, 1963; Lewis et al., 1992). Even genetic differences in response to photoperiod were inferred (Shanawany, 1993b). In this respect, the previous observation of a significantly earlier initiation of egg lay by a step-up photoperiod from 6h to 12h given at the end of 90 days (Chapter 1) was more prominent than the advancement noted by Lewis *et al.* (1996a) in ISA Brown and Shaver 288 breeds by a step-up photoperiod from 8 to 13h given at the end of 84 days. Apparently, an increase in photic schedule given to RIR pullets has favourable influence on reproductive potential and egg productivity.

Though gonadotrophic hormones are principle hormones controlling reproductive functions, adrenal corticoids and thyroid hormones are also being implicated in recent times 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). In this respect, a definite but differential interrelationship between the hormones of the thyroid and adrenal and, gonadal functions, have been envisaged in adult avian species as reviewed earlier (Chapter 2; 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). The above study, identified a lacuna in terms of studies involving adrenal and thyroid glands in immature birds and to that end made an attempt to evaluate the effects of HPR or HPO in growing pullets upto 90 days of age on various aspects of egg laying performance subsequent to attainment of sexual maturity. The results obtained in the study suggested some subtle favourable influence of both HPR and HPO on different aspects of the overall laying performance (Chapter 2).

From the above detailing it is evident that both photoperiodic manipulation as an exogenous factor and manipulation of corticosterone levels as an endogenous factor in the sexually immature growing phase of the domestic hen have potential effects on attainment of sexual maturity and egg productivity. The objective of the present study was to test the combined effect of either HPR or HPO and a short photoperiod in RIR pullets till 90 days of age on the age at sexual maturity and various aspects of the egg laying performance. Further, adult hens of 72 weeks of age (end phase of first lay) were also subjected to a similar experimental schedule for 1 month to evaluate the possible effects on the second cycle of lay.

RESULTS

Set-up I

Body weight and duration of egg laying :

The body weight of both HPR and HPO birds was significantly more than the control birds throughout, except for HPR birds during the first month. At 180 days, the HPR and HPO birds were heavier by 9% and 12% respectively. The growth rate was consistently higher in the HPO birds till 120 days while it was so in the HPR birds only between 30 and 90 days. Both the control and HPO birds showed maximum growth rate between 90 and 120 days while the HPR birds depicted a maximum growth rate between 60 and 90 days. These changes in the body weight and growth rate are shown in tables 1&2; figs. 1&2. All the three groups of birds initiated egg laying at the end of 4 months with the HPO birds showing a slight delay of 9 days. The termination of egg laying occurred 9 days earlier in the HPR birds while it occurred 13 days later in the HPO birds. The effective number of days of egg laying was lesser by 12 days in the HPR birds while it was slightly extended by 4 days in the HPO birds (tables 3; 4; fig. 3 A - C & 4 A - C).

Number and weight of eggs and rate of lay:

The average total egg yield/hen was 193.68 eggs in the control birds and 197.73 (marginally more) and 184.53 (significantly lower) in the HPR and HPO birds respectively. The number of small eggs (<40 gms.) laid was lesser in HPR birds and slightly more in HPO birds; as a result, the difference in terms of effective no of eggs became significantly more (by 9 eggs) in HPR birds and Less (by 12 eggs) in HPO birds. The overall rate of lay was 0.57 and 0.51 egg/day with an oviposition interval of 42 and 47 hr respectively in HPR and HPO birds as against 0.54 egg/day with an oviposition interval of 44 hrs in the control birds (table 4).

The overall egg weight was greater in the HPO birds (46.08 V/s 44.68) and similar (45.12 V/s 44.68) in the HPR birds compared to the control (table 5).

Monthly variation in the 1st lay :

The data on the average monthly yield shows higher productivity of 60% or more eggs in the first 5 months in the control birds with the maximum of 78% in the 2nd and 4th months. The HPR birds showed a yield of 60% or more for the first 6 months with the maximum yield of 78% during the 2nd month while, the HPO birds showed above 60% production during the first 5 months with a maximum of 74% only during the 3rd month. Overall, the monthly yield of eggs from 6 to 12 months was relatively more in the HPR birds. The HPO birds in general showed a slightly lower monthly yield throughout. All the three groups of birds attained 50% egg production (EP) at 19 weeks of lay (table 6; fig.5a).

Table 1. Body weight gain (in gms.) upto 180 days in control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

	30 DAYS	60 DAYS	90 DAYS	120 DAYS	150 DAYS	180 DAYS
HPR	94.16 ±11.35	324.00 ±15.70	692.50[c] ±15.76	980.43[c] ±20.63	1142.55[c] ±024.37	1210.81[b] ±021.22
CONT	122.50 ±19.25	322.00 ±13.13	533.33 ±15.87	840.75 ±23.54	1013.33 ±022.11	1108.64 ±023.42
HPO	156.66 ±16.49	353.33 ±20.54	656.00[b] ±33.23	1052.38[c] ±021.13	1180.26[c] ±019.44	1240.38[c] ±025.13

Values : Mean, ±S.E, N= 12.[b]P < .005, [c]P < .0005.

Table :2 Table showing growth rate in control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

	30 days	60 days	90 days	120 days	150 days	180 days
HPR	2.25[b] ±.32	7.66 ±.86	12.28[b] ±1.21	9.59 ±.65	5.4 ±.68	2.27 ±.55
CONT	3.41 ±.19	6.65 ±1.02	7.04 ±.95	10.24 ±.63	5.9 ±.49	3.17 ±.48
HPO	4.33 ±.53	6.55 ±.74	10.08[a] ±.69	13.21[b] ±.72	4.26 ±.66	2.00 ±.78

Values : Mean, ±S.E, N= 12.[a]P < .05, [b]P < .005.

Table : 3 Age at which initiation and termination of egg laying occurred in control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

	Initiation (days)	Termination (days)	Effective days of lay
HPR	123.81 ±02.37	467.28 ±03.19	344.63[b] ±02.19
CONT	120.74 ±03.45	476.45 ±04.65	356.25 ±03.43
HPO	129.23[a] ±03.17	489.71[b] ±02.98	366.18[b] ±03.17

Values : Mean, ±S.E, N= 12.[a]P < .05, [b]P < .005.

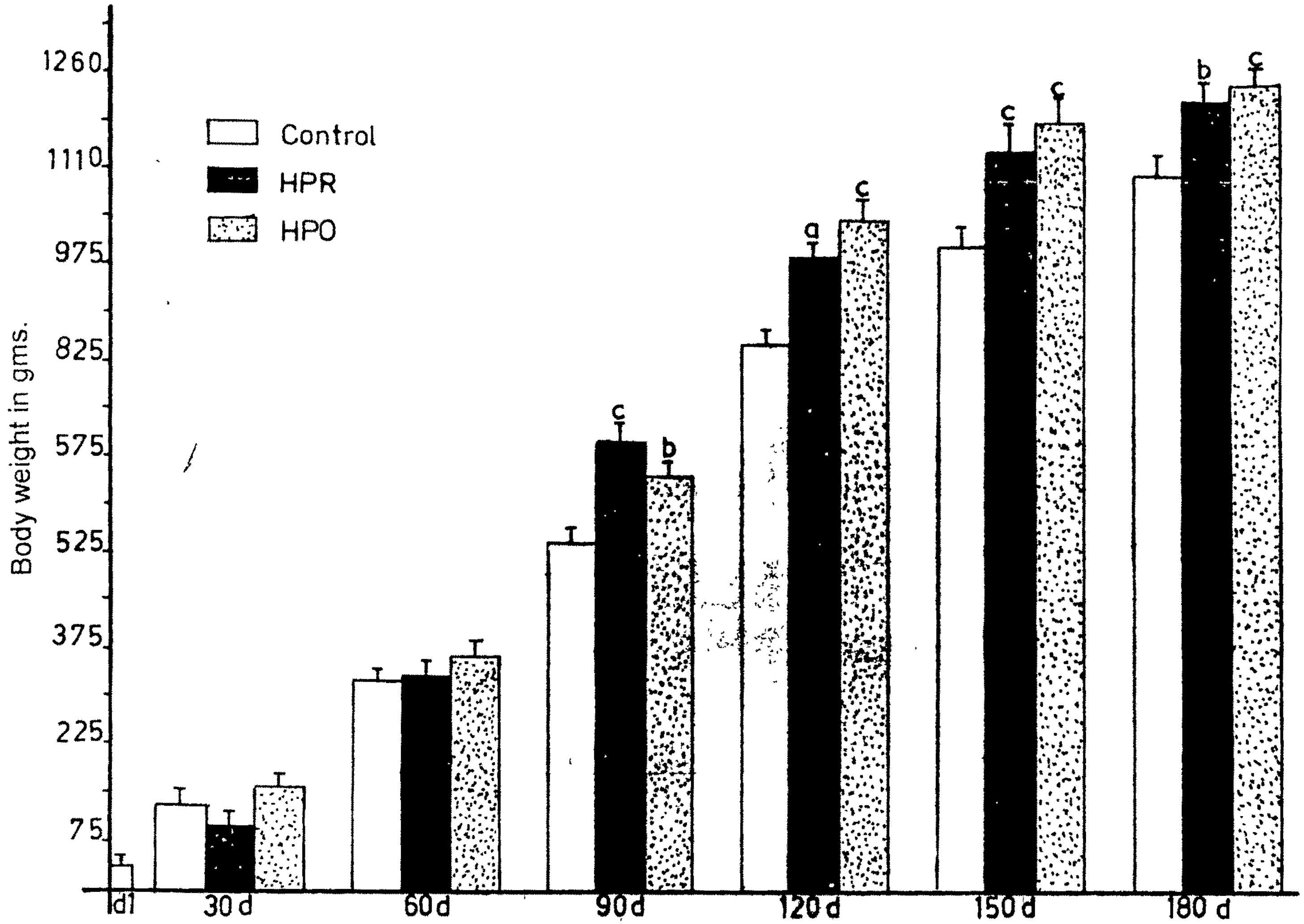

Fig.1 Body weight gain in Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under SP. (SP - LD 6 :18)
Values : Mean, ±S.E, N= 12 **$^{a}P < .05$, $^{b}P < .005$, $^{c}P < .0005$**

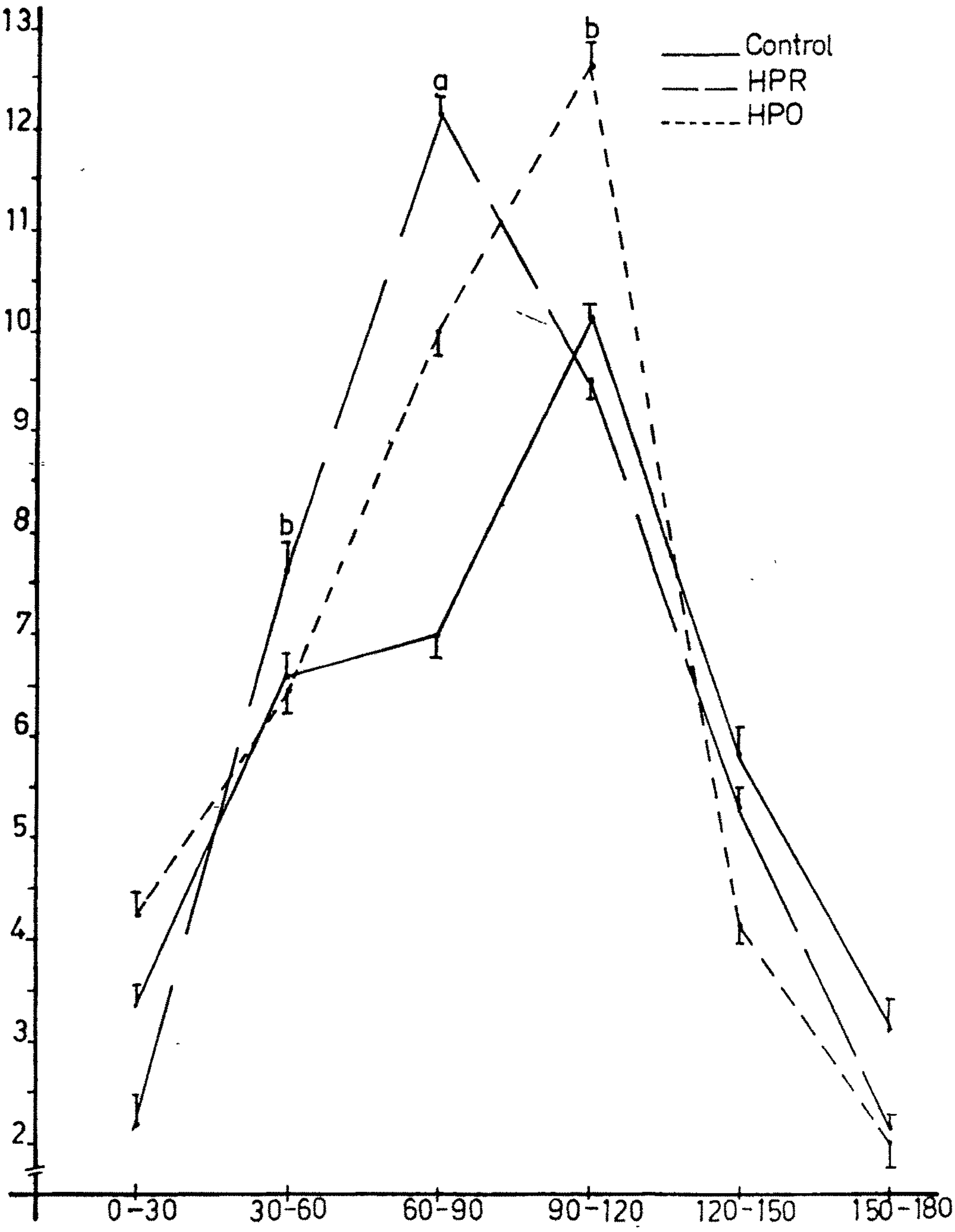

Fig.2 Per day growth rate in Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under SP
Values . Mean, ±S.E, N= 12 **^{a}P < .05, ^{b}P < .005.** C- Control (SP).
SP - LD 6 18

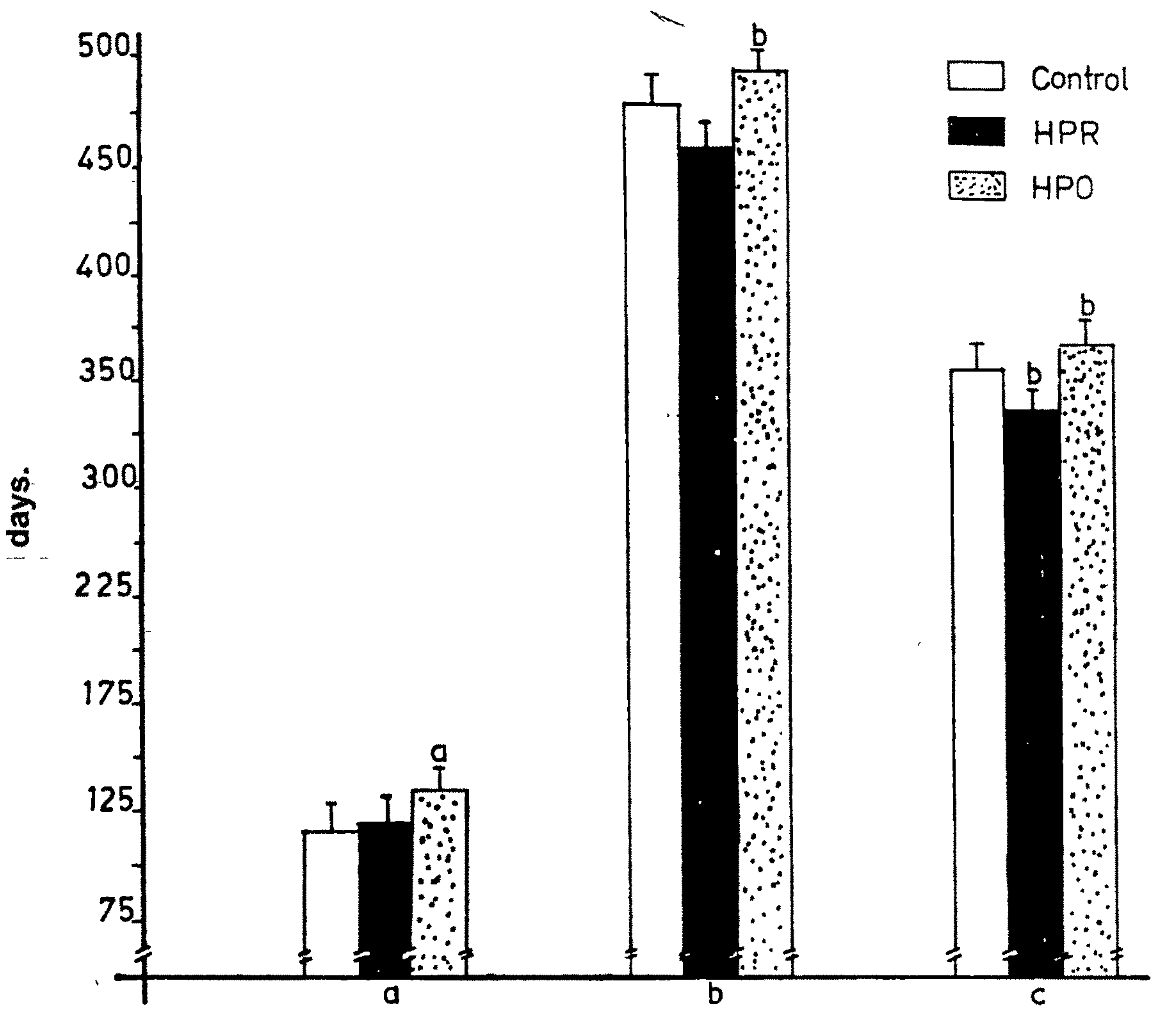

Fig.3 Figure showing age at initiation (A), termination (B) and effective number of days of lay of Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under short photoperiod (SP) Values : Mean, ±S.E, N= 12 [a]**P < .05,** [b]**P < .005.** C- Control (SP), SP - LD 6 :18

Table :4 Laying performance of first lay in control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

	Total no. of eggs.	Total no. of small eggs/hen		Total no. of effective eggs/hen	Rate of lay	
		Number	*%*		**eggs/day**	**mean oviposition interval in hrs.**
HPR	197.73 ±3.76	18.41 ±1.93	9.1	179.36[a] ±2.83	0.57	42
CONT	193.68 ±4.26	23.43 ±2.64	11.9	170.25 ±3.54	0.54	44
HPO	184.53[a] ±2.23	26.28 ±3.13	14.1	158.78[b] ±3.17	0.51	47

Values : Mean, ±S.E, N= 12. [a]$P < .05$, [b]$P < .005$.

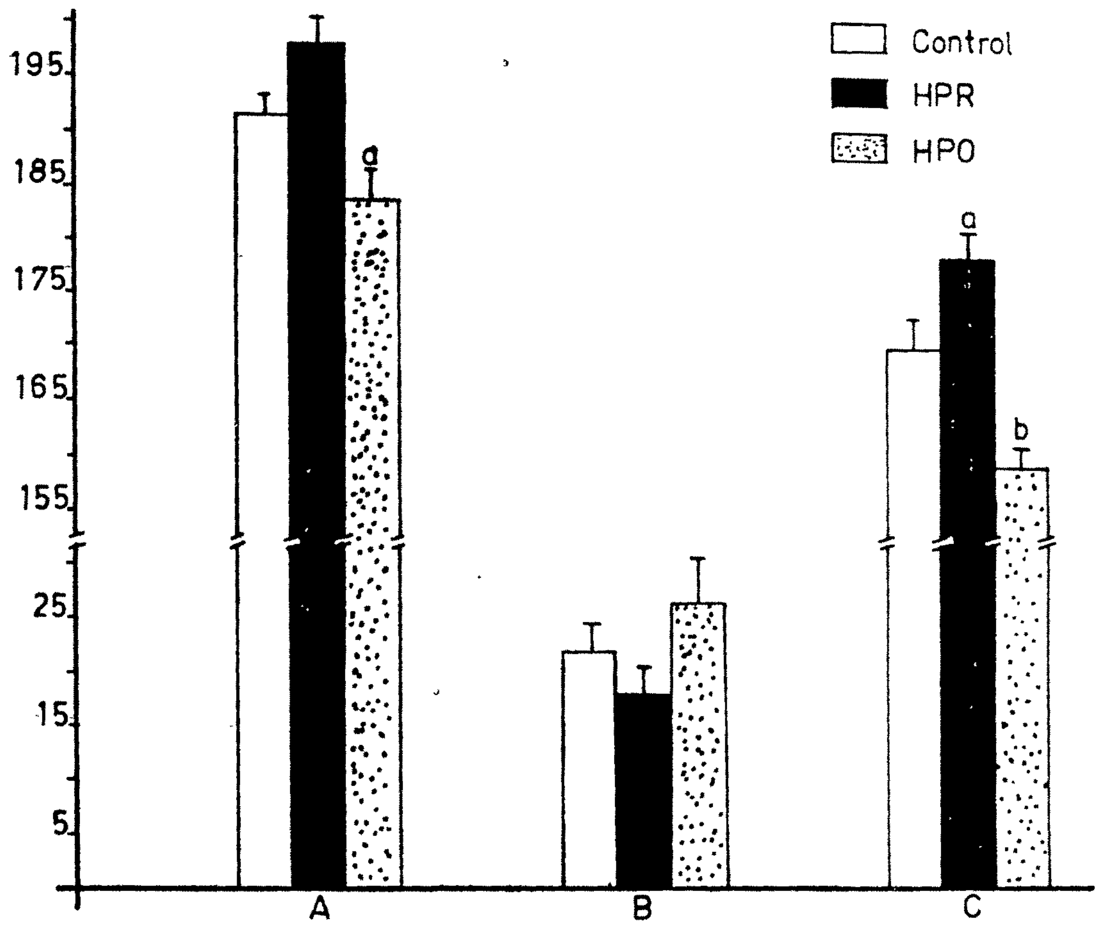

Fig. 4 Figure showing egg laying performance of Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under short photoperiod (SP).

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

Table:5 Mean monthly(M) and average egg weight (gms) in control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

	1 M	2 M	3 M	4 M	5 M	6 M	7M	8M	9M	10M	11M	12M	Overall egg wt.
HPR	35.71 ±1.11	38.28 ±1.12	41.23 ±1.17	42.61 ±1.22	47.23 ±0.87	46.79 ±0.98	48.23 ±1.07	48.71 ±0.81	47.66 ±0.82	47.23 ±0.92	49.2^{a} ±0.08	49.76 ±0.86	45.12 ±1.50
C	33.46 ±1.26	36.19 ±1.82	43.81 ±1.20	43.71 ±0.89	49.43 ±1.19	47.39 ±1.06	47.58 ±1.23	47.13 ±1.18	46.11 ±0.68	47.73 ±1.12	47.69 ±0.79	49.67 ±0.87	44.68 ±1.76
HPO	37.21^{b} ±1.20	39.39 ±1.50	43.71 ±1.18	44.61 ±0.94	46.71^{a} ±0.81	48.22 ±0.90	47.64 ±0.84	48.29 ±0.62	48.6^{b} ±0.89	49.61 ±1.06	49.13 ±0.90	49.83 ±0.77	46.08 ±1.39

Values : Mean, ±S.E, N= 12. ${}^{a}P < .05$, ${}^{b}P < .005$.

Table:6 Table showing number of eggs/month, numberof clutches/month and average monthly clutch size of control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

	No of eggs per month			***No. of clutches per month***			***Average monthly clutch size***		
M	***HPR***	***C***	***HPO***	***HPR***	***C***	***HPO***	***HPR***	***C***	***HPO***
1	21.66 ±1.11	22.66 ±0.52	20.00[a] ±1.12	6.00 ±1.00	7.66 ±0.54	9.36 ±1.47	3.61 ±0.36	3.00 ±0.36	2.14 ±0.28
2	23.37 ±1.38	23.33 ±0.68	21.66 ±1.25	5.37 ±.57	6.33 ±0.57	5.38 ±0.57	4.37[a] ±0.17	3.69 ±0.23	4.06 ±0.14
3	21.28 ±0.73	21.00 ±1.00	22.27 ±0.62	4.66[c] ±0.72	8.66 ±0.57	5.03[b] ±0.72	4.57[b] ±0.73	2.42 ±0.08	4.45[c] ±0.03
4	21.59[a] ±0.51	23.34 ±0.72	20.00[a] ± 1.78	6.66 ±0.39	6.33 ±0.58	7.66 ±1.52	3.42 ±0.19	3.70 ±0.37	2.60[a] ±0.27
5	18.30 ± 1.15	19.01 ±1.02	18.34 ±2.30	7.39 ±0.82	8.33 ±0.54	7.76 ±0.35	2.49 ±0.32	2.29 ±0.43	2.29 ±0.23
6	18.67 ± 1.15	17.70 ±2.30	17.47 ±2.08	8.72 ±0.75	8.66 ±0.57	8.00 ±1.02	2.23 ±0.41	2.04 ±0.38	2.18 ±0.43
7	16.38 ±0.47	15.33 ±2.50	14.51 ±0.62	9.36 ±0.27	9.33 ±1.15	10.01 ±0.33	1.69 ±0.68	1.68 ±0.50	1.45 ±0.37
8	15.33 ± 0.70	14.33 ±0.57	13.37 ±1.03	12.02[a] ±0.78	10.33 ±0.59	10.60 ±1.54	1.24 ±0.17	1.39 ±0.11	1.25 ±0.12
9	13.84 ±0.64	14.00 ±1.00	11.77[a] ±0.53	11.89 ±0.24	10.33 ±0.57	9.33 ±0.52	1.18 ±0.14	1.35 ±0.12	1.26 ±0.16
10	13.45[b] ±0.84	10.33 ±0.57	10.44 ±0.70	10.70[c] ±0.17	8.00 ±0.06	9.00[a] ±0.50	1.13 ±0.23	1.29 ±0.12	1.19 ±0.21
11	13.00 ±1.72	9.33 ±1.52	8.59 ±1.15	10.12[c] ±0.58	7.00 ±0.03	9.00b ±0.73	1.06 ±0.29	1.33 ±0.21	1.02 ±.81
12	4.51 ±0.37	4.00 ±0.04	4.56 ±0.64	3.74 ±0.39	3.33 ±0.57	4.66[a] ±0.23	1.20 ±0.13	1.22 ±0.19	0.95 ±.13

Values : Mean, ±S.E, N= 12. [a]P < .05, [b]P < .005, [c]P < .0005

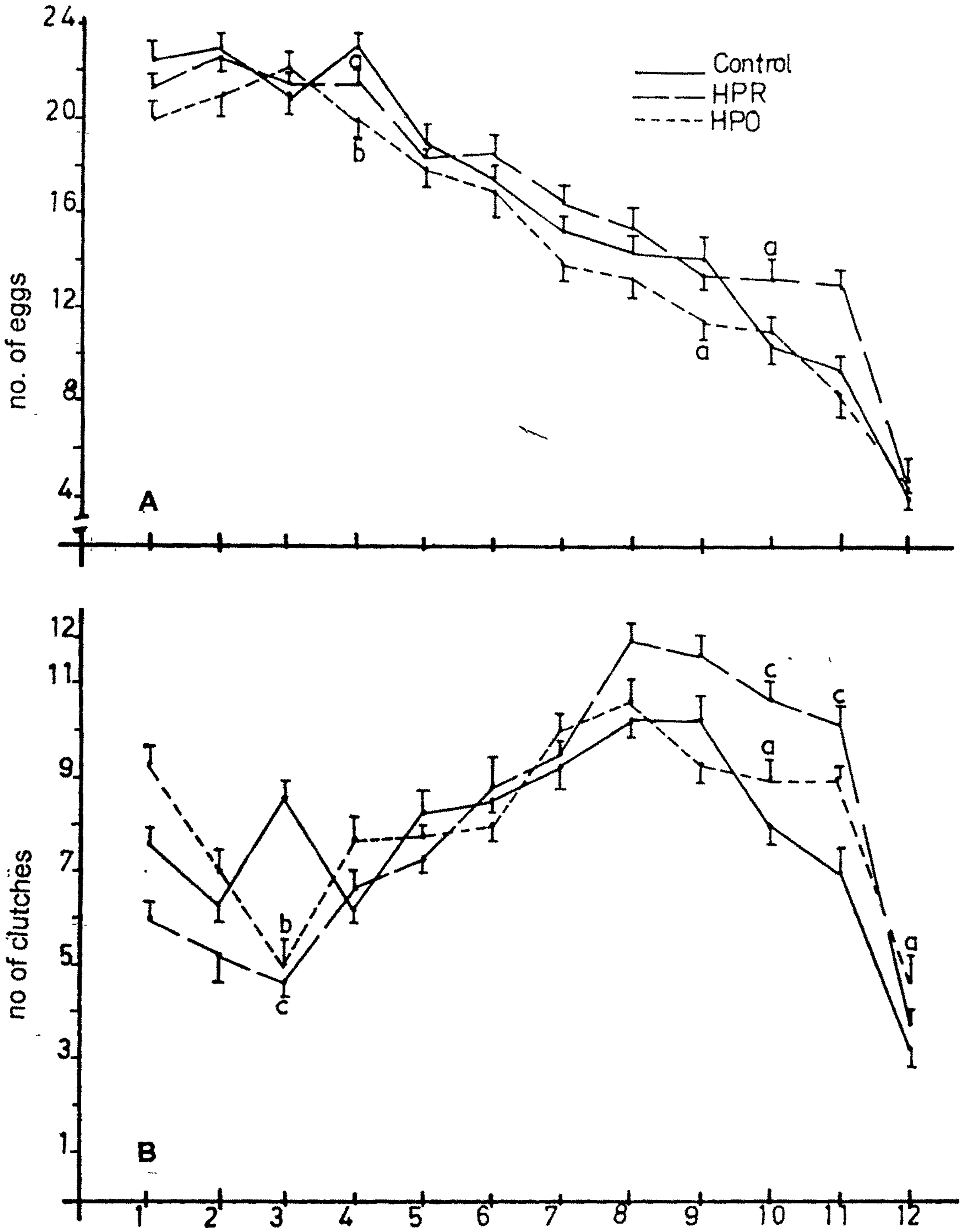

Fig. 5A & B Figures showing average monthly egg production(A); and average number of clutches (B) in Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets reared under SP.
Values : Mean, ±S.E, N= 12 C- Control (SP), SP - LD 6 :18

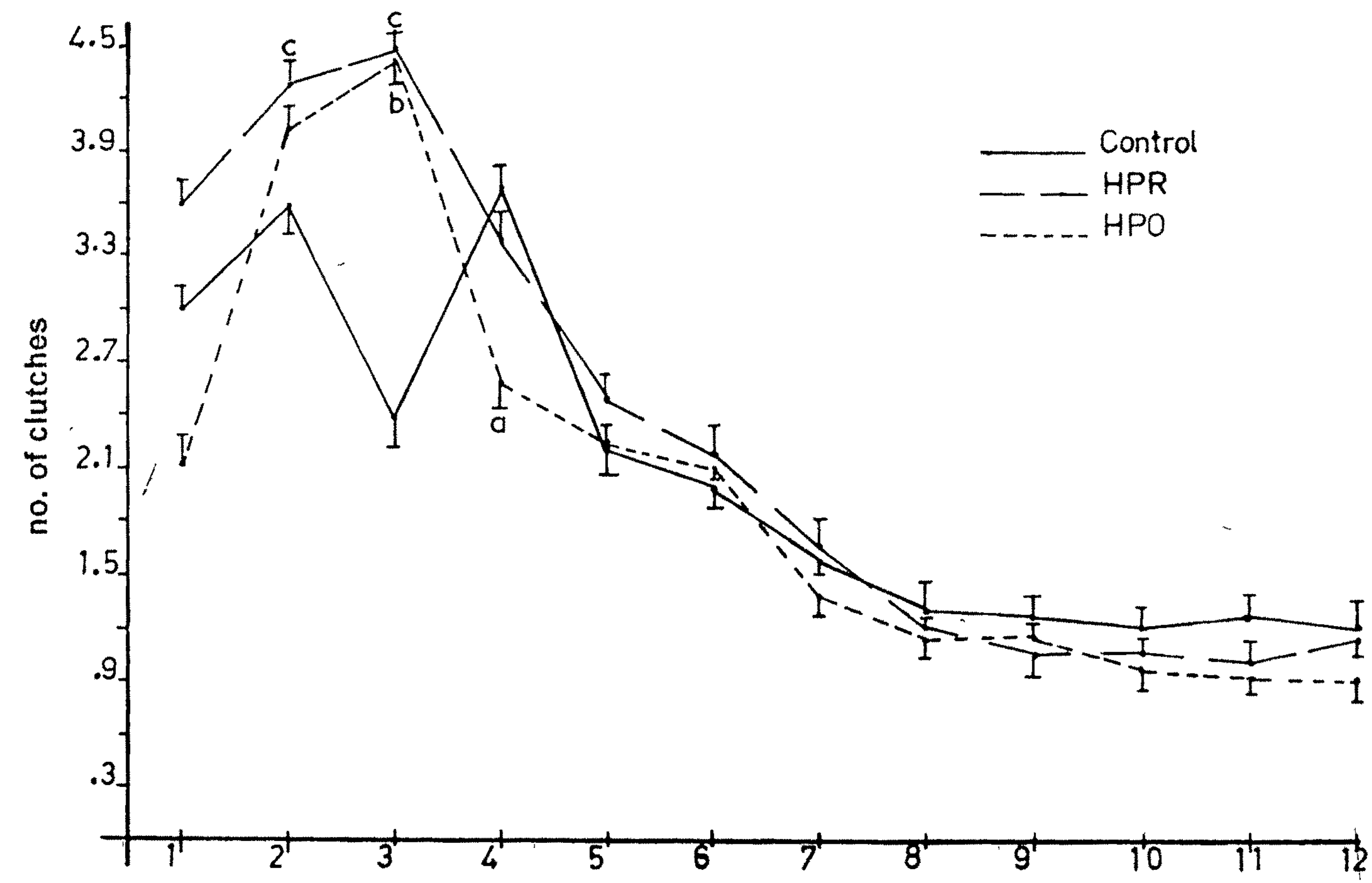

Fig. 6 Figure showing monthly average clutch size
C - Control, HPR - Hypercorticalic and HPO - Hypocorticalic.

Values : Mean, ±S.E, N= 12

Table : 7 Monthly variation in the average number of clutches of various sizes laid by control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets.

Clutches of various sizes	1 Month			2 Months			3 Months			4 Months			5 Months		
	HPR	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*	*HPR*	*C*	*HPO*
1	0.50^{a} ±.03	1.00 ±.25	5.01^{c} ±.23	---	---	0.68 ±.07	---	0.66 ±.21	---	---	---	2.35 ±.91	2.66 ±.11	2.66 ±.11	0.69^{c} ±.08
2	0.33^{a} ±.07	1.00 ±.25	1.67 ±.98	0.33^{c} ±.02	1.00 ±.09	---	0.33^{c} ±.08	1.66 ±.09	0.34^{c} ±.01	1.67^{c} ±.08	0.33 ±.06	3.03^{c} ±.05	1.00^{c} ±.02	3.00 ±.08	4.42^{a} ±.66
3	2.00 ±1.73	3.00 ±.99	2.31 ±.57	1.66 ±.08	2.00 ±.12	0.61^{c} ±.05	1.58 ±.52	1.66 ±.13	1.04^{c} ±.09	2.08 ±1.5	2.66 ±.57	0.66^{b} ±.04	2.60 ±.23	2.00 ±.69	2.04 ±.08
4	1.66 ±.94	1.66 ±.57	0.33 ±.08	0.68^{c} ±.04	1.33 ±.57	2.03 ±1.2	2.05^{c} ±.07	1.33 ±.28	0.60^{b} ±.04	2.02 ±.07	1.66 ±.57	1.02 ±.08	1.03 ±.02	1.00 ±.17	1.00 ±.80
5	1.33 ±.57	0.66 ±.19	---	0.60^{a} ±.14	1.66 ±.57	1.68 ±.51	0.30^{c} ±.11	1.33 ±.31	1.59 ±.50	0.29 ±.04	1.66 ±.52	0.31^{b} ±.02	---	---	---
6	---	0.33 ±.09	---	1.66 ±.12	---	0.33 ±.03	---	---	1.34 ±.07	---	---	0.30 ±.06	---	---	---
7	---	---	---	0.33 ±.04	---	---	---	---	---	---	---	---	---	---	---
8	---	---	---	0.33 ±.05	---	---	---	---	---	---	---	---	---	---	---

Values : Mean, ±S.E, N= 12. $^{a}P < .05$, $^{b}P < .005$, $^{c}P < .0005$. Continued

Table :7 Monthly variation in the average number of clutches of various sizes laid by control (C), Hypercorticalic (HPR) and Hypocorticalic (HPO) pullets. **(Continued)**

Clutches of various sizes	***6 Month***			***7 Months***			***8 Months***			***9 Months***			***10 Months***		
	HPR	***C***	***HPO***	***HPR***	***C***	***HPO***	***HPR***	***C***	***HPO***	***HPR***	***C***	***HPO***	***HPR***	***C***	***HPO***
1	3.33^{a} ±.57	1.33 ±.54	2.02 ±.03	4.66 ±.94	4.33 ±.98	6.66^{a} ±.57	10.0^{a} ±1.17	6.66 ±1.15	8.00 ±1.73	9.60^{a} ±1.03	6.33 ±1.1	7.33 ±.57	9.36^{a} ±.81	6.00 ±1.2	7.63 ±.73
2	3.03 ±.07	5.33 ±1.52	4.00 ±1.73	4.33 ±.04	4.00 ±.93	4.03 ±.05	1.66b ±.07	3.33 ±.57	2.66 ±.57	2.02 ±.82	4.00 ±1.7	2.00 ±.08	1.70 ±.60	1.66 ±.57	1.39 ±.22
3	1.09 ±.17	1.66 ±.52	1.52 ±.33	1.66^{c} ±.08	1.00 ±.08	0.33^{c} ±.06	0.60^{a} ±.12	0.33 ±.06	---	---	---	---	---	0.33 ±.06	---
4	1.30^{c} ±.09	0.33 ±.06	0.71^{c} ±.06	---	---	---	---	---	---	---	---	---	---	---	---
5	0.30 ±.11	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Clutches of various sizes	*11 Month*			*12 Months*		
	HPR	*C*	*HPO*	*HPR*	*C*	*HPO*
1	9.33^{b} ±.88	5.33 ±1.1	8.31 ±1.5	3.80^{a} ±.17	2.33 ±.52	4.07^{b} ±.35
2	1.07 ±.12	1.33 ±.57	0.62 ±.08	---	1.07 ±.23	---
3	---	0.33 ±.08	---	---	---	---

Values : Mean, ±S.E, N= 12. $^{a}P < .05$, $^{b}P < .005$, $^{c}P < .0005$

Table:8 Average monthly rate of egg laying in hypercorticalic (HPR) and hypocorticalic (HPO) birds under SP

	eggs/day			mean oviposition interval (in hrs)		
	HPR	*C*	*HPO*	*HPR*	*C*	*HPO*
1	0.72	0.75	0.66	33.12	31.68	36.0
2	0.77	0.77	0.72	30.72	30.72	33.12
3	0.70	0.70	0.74	33.60	34.08	32.16
4	0.71	0.77	0.66	33.12	30.72	36.00
5	0.61	0.63	0.61	39.12	37.68	39.12
6	0.62	0.59	0.58	38.40	40.56	41.04
7	0.54	0.51	0.48	48.92	46.80	49.44
8	0.51	0.47	0.44	46.80	50.16	53.76
9	0.46	0.46	0.39	51.80	51.86	60.96
10	0.44	0.34	0.34	53.50	69.60	68.88
11	0.43	0.31	0.28	55.20	77.04	83.76
12	0.15	0.13	0.15	159.60	180.0	157.6

Values : Mean

Table :9 A comparative projection of total amount of feed consumed / bird (in Kg) till the end of lay and feed/dozen eggs

	Government (Govt.) Poultry	*Present Experimental regimen*		
		HPR	*C*	*HPO*
Total number of days	530.00	467.530	476.680	489.710
Total feed/bird (kg)	63.500	45.550	46.400	47.850
Difference				
Govt. V/s C	---	----	-17.10(27%)	---
Govt V/s HPR	---	-17.95(26%)	----	----
Govt V/s HPO	---	---	----	-15.65(24%)
C V/s HPR	---	-0.85 (2%)	----	----
C V/s HPO	---	---	----	+ 1.45 (3%)
Feed / dozen eggs.	4.23	2.77	2.96	3.12

An average clutch size of 2 or more occurred in all the 3 groups of birds during the first 6 months, whereafter the clutch size remained below 2. The maximum clutch size of 4 was shown by both HPR and HPO hens during the 2nd and 3rd months, while it was only of 3 in the control birds during the 1st, 2nd and 4th months. The minimum number of clutches laid during the active egg laying period was 5 in the HPO birds during the 2nd and 3rd months and 4 in the HPR birds during the 3rd month, while it was 6 in the control birds in 2nd and 4th months (table 6; fig.6).

The average number of clutches of various sizes during the 1st year of lay (table 7) shows that, while the control birds laid a maximum clutch of 6 in the 1st month, the HPO birds laid a similar clutch size during the 2nd, 3rd and 4th months. In contrast, the HPR birds laid clutches of 6, 7 and 8 eggs during the 2nd month (table 6; fig.5b).

Set-up II

All the three groups of birds studied for their second lay showed no egg laying during the four months of observation (i.e from 72 to 88 weeks of age).

DISCUSSION

Owing to the lack of studies involving photoperiodic manipulations in the Indian breeds of Poultry, a previous study on rearing of pullets under SP followed by shifting to natural photoperiodic conditions amounting to a step-up photoperiodic schedule, as employed in the present study, had shown significant favourable influence on laying performance of Indian RIR breed (Chapter 1). Further, another study carried out on on altered adrenocortical status during the growing phase of RIR pullets also revealed some subtle but definite influence on certain aspects of the first cycle of lay (Chapter 2). The present study involving a combination of the above two experimental schedules has revealed further modulatory interactions of both photoperiod and adrenocortical status on laying performance. The initiation of lay which occurs at 120 days in the control group represents an advancement by 58 days compared to maintenance under normal photoperiodic conditions as inferred earlier (Chapter 1). Neither HPR nor HPO condition seems to have any significant effect over that of short photoperiod in this respect, except for a slight delay by 9 days under HPO condition. But the HPO condition did not affect the overall duration of laying as the termination of lay also occurred slightly later. However, the HPR condition reduced the duration of the laying period significantly by 12 days as a consequence of early cessation of egg laying coupled with a slight delay in initiation. The total yield of 193 eggs during the first cycle of lay in the control birds, which represents an increment by 25 eggs/hen compared to the yield of 168 eggs under natural photoperiodic conditions (Chapter 1), was further bettered to 29 eggs/hen under HPR status. Obviously, HPR in the growing phase has an additive influence over that of a step-up photoperiod on the total yield of eggs. In contrast, HPO during the growing phase has a significantly negative influence on the effect of a step-up photoperiod (193 V/s 184 eggs). Nevertheless, it is still significantly more than the yield under natural photoperiodic condition (184 V/s 168 eggs). The overall improvement in terms of egg output, per day rate of lay and the interval between two eggs was by 20% in HPR birds as against only 15% under SP conditions (Chapter 2), attesting to additive favourable influence of hypercorticalism. However, HPO birds showed a 5% poor response in these terms compared to SP birds. Moreover, the number of effective eggs (weighing > 40gms) was better by 5% in HPR condition and poor by 7% in HPO condition. The increment in HPR condition was over and above the 12% under SP alone compared to NLD (Chapter 2) and thereby again suggesting an additive influence of HPR over SP.

The growth kinetics in terms of changes in body weight reveals that, both HPR and HPO birds weighed heavier than the control birds with the former being the heaviest at 90 days and the latter heaviest at 180 days. The fact that there is no positive correlation between body weight and reproductive maturity as inferred earlier (Lewis *et al.,* 1996 a, b; Chapter 1) is further emphasised by the present observation of higher body weights in HPR and HPO birds compared to the control SP birds though the IL was earliest in the latter. Past literature bears ample testimony to the fact that both hypercorticalism and hypocorticalism have retardatory influence on body weight in the adult domestic fowl (Davison *et al.,* 1979; Harvey and Scanes, 1979; Gross *et al.,* 1980; Bartov, 1982; Davison *et al.,* 1983; Saddoun *et al.,* 1987; Brake *et al.,* 1988). Moreover, similar retardatory influence was demonstrated in white leghorn chicks as well (Joseph and Ramachandran, 1992). The present observation of increased body weight under both conditions appears contradictory. However, an effective explanation can be sought from the fact that the present study involves continuous release of the responsible agents in low doses as against acute or chronic injections in the above studies. Obviously, treatment schedules in terms of continuous release or timed injections and the dosage may have greater relevance on the influence of altered corticosterone levels on growth and body weight in the domestic fowl.

A comparison of growth rate in the three groups of birds revels that while the SP and HPO groups recorded their maximal rates between 90 and 120 days, the HPR group showed its maximum rate between 60 and 90 days. The increase in body weight shown by both HPR and HPO birds cannot be related either with food intake or with fattening as all the groups of birds were given fixed amount of timed rationed diet and there was no evidence of fat deposition. The effect therefore has to be ascribed to better anabolic response.

Weight of the first egg at IL was significantly more in both HPR and HPO by 2 gms and 3 gms respectively. A comparison of the total number of small eggs laid by the three groups shows that, while 11.9% of the total eggs laid were small in the SP group, the same were 9.1% (significantly less) and 14.1% (significantly more) in HPR and HPO groups respectively.

Closer analysis of the laying performance indicates that all the three groups attain 50% egg production approximately at 19 weeks. This suggests that neither HPR nor HPO has any influence on the SP induced earlier attainment of 50% EP by 2 weeks as compared to NLD birds (Chapter 2). The mean monthly egg weight is more in the HPO birds throughout the year except for the 5th month while, in the HPR birds it was very much comparable to the controls. Apparently hypocorticalism is able to nullify the effect of SP on egg weight as the egg weight in the HPO birds is similar to that of NLD birds (Chapter 1,2). A maximal monthly egg yield of 60% or more occurred in all the three groups in first five months with the control birds yielding the highest number and the HPO birds lowest number of eggs during that period. However, from the 6th month onwards, the monthly yield was consistently more in the HPR birds and less in HPO resulting ultimately in a net increased lay in the HPR birds and decreased lay in the HPO birds.

In the previous study, it was shown that HPO has a retardatory influence on overall egg yield, though better between the 3rd and 7th month, under normal photoperiodic conditions (Chapter 2). Taking together, it suggests that HPO in pullets has a retardatory influence on total egg yield by differential effects depending on the rearing photoperiod. The mean monthly clutch size shows a similar distribution of clutches of 2 or more eggs during the first 6 months, and clutches of less than 2 eggs in the remaining 6 months. But both HPR and HPO birds showed a maximum clutch size of more than 4 eggs during the 2nd and 3rd months, not obtained for the control birds. Except for these 2 months, the mean clutch size during all the other months is relatively greater in the HPR birds and lower in the HPO birds (table 6). A comparison of the monthly mean of number of clutches during the effective lay period of 11 months shows that, while the control and HPO birds showed a minimum to maximum range of 6-10 and 5-10 respectively, the HPR birds showed a range of 4-12. The positive influence of HPR and the negative influence of hypocorticalism on the overall laying performance are further emphasized by the observed range of 0.43-0.77 egg/day with the mean oviposition interval of 30h-55h in the former and a range of 0.28-0.74 egg/day with mean oviposition interval of 32h-83h in the latter as against a range of 0.31-0.77 egg/day with mean oviposition interval of 30h-77h in the control birds (Table 8). A comparison of the number of clutches of various sizes laid by the RIR hens under NLD and SP conditions had shown that, while the NLD birds laid clutches of 4 eggs regularly during the first 6 months, and a clutch of 5 eggs only during the 2nd month, the SP birds laid clutches of 5 eggs regularly during the first 4 months and 1/3rd of the birds laid a clutch of 6 eggs during the 6th month. In the present study it is revealed that, while all the HPO birds laid a clutch of 6 eggs in the 2nd month and 1/3rd of them even during the 2nd and 4th months, all the HPR birds laid a clutch of 6, and 1/3rd of them even a clutch of 7 and 8 eggs during the 2nd month(table 6; fig.6). Apparently, HPR has an additive influence on SP in terms of clutch size.

The data on feed consumption also reveals, in terms of amount of feed/dozen eggs, a marginal reduction in the HPR birds and a marginal increment in the HPO birds. In terms of total feed consumed, the HPR birds shows a decreased consumption by 1 kg/bird and the HPO birds, an increase by about 1.5 kg/bird (table 9). This though appears to be not very significant when viewed on a per bird basis, becomes more meaningful and significant in terms of overall economy on the basis of cost analysis of a large flock of 5000 birds or more as maintained in a poultry farm. Obviously, HPR condition has a further favourable additive influence on the overall cost economy over that of exposure to SP alone as revealed earlier (Chapter 1).It may also be mentioned that a timed rationed diet as provided in the present study, which at an average is 16% less than the feed consumption of the birds in the government poultry farm in Baroda, has no effect on the overall laying performance of the birds, as has been discussed previously (Chapter 1).

In the previous study on SP, it was observed that exposure of adult hens towards the end of their 1st lay (72 weeks of age) to a short photoperiod of L:D 6:18 for 1 month (i.e 76 weeks of age) resulted in a total cessation of second cycle egg laying (Chapter 1). Even in the present study, superimposition of either HPR or HPO during the period of exposure to SP did not have any influence. Apparently the SP induced inhibition of ovarian functions is not being overcome by either HPR or HPO. Since the dosage of corticosterone and metapyrone used in this study is the same as that used in the pullets, it remains to be seen as to whether an increased dosage of them resulting in greater perturbations in the corticosterone level, especially an HPR state would have any consequential effects.

Overall, the present study provides evidence for a potentiating effect of hypercorticalism and, a partial negative influence of hypocorticalism on the favourable influence of a step-up photoperiod, in terms of laying performance.