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EFFECT OF PHOTOPERIOD ON GROWTH, FOOD CONSUMPTION AND BREEDING BIOLOGY OF JAPANESE QUAIL, *CORTUNIX COTURNIX JAPONICA*

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ABSTRACT Japanese quail is one of the popular laboratory animals for scientific research. The aim of the study was to determine the effect of photoperiod on growth, food consumption and breeding biology of quails in laboratory at Manipur University, Canchipur (Latitude 24.82^{0}N and Longitude 93.95^{0}E). The experimental protocol included exposure of one animal group to continuous light (LL) and another group to normal day length (NDL) and the experiment was conducted for ninety days (90) and repeated during early summer (3rd week of May to 2nd week of August, 2011), summer (2nd week of July to 1st week of October, 2011) and winter (1st week of December 2011 to 1st week of March, 2012).During early summer the average body weight of adult birds in LL increased significantly (P<0.05) compared to NDL, 258.00 ± 15.55 gms (LL), 218.98± 2.75 gms (NDL). Food consumption values were higher in LL groups than NDL groups in all the seasons studied. In summer the average body weight of NDL and LL showed no significant difference 243.97±20.04 gms (LL), 241.80 ± 11.01 gms (NDL) 245.95± 10.43gms (LL), 224.53 ± 12.06gms (NDL). However in winter average body weight in LL increased significantly compared to birds exposed to NDL. The commencement of egg laying was on 58th day in early summer, 53rd in summer, and 54th day in winter in all LL groups whereas there was no egg laying in NDL groups in early summer, summer and in winter commencement of egg laying was on 84th day of rearing. Five (5) eggs were laid by the quails exposed to winter months during the study period. In general, quails subjected to continuous light attained earlier sexual maturity than those subjected to normal photoperiod.

KEYWORDS : Japanese quail, Photoperiod, Body weight.

INTRODUCTION

It is widely documented that the timing of reproduction is controlled by external signals such as seasonal changes in day length or photoperiod, chemosensory from con-species, food availability and temperature. Timing of breeding to an optimal season is a requirement for a successful reproductive outcome and many other organisms evolved to use changes in photoperiod as the primary signal that co-ordinates the breeding season [1, 2]. Majority of the species outside the tropics rely on food resource for their young that become available for a predictable period each year [3]. The lengths of breeding season are asymmetrical with changes in photoperiod. Long photoperiods have two effects, the firsts is photostimulation leading to gonadal maturation and the second is the induction of photorefractoriness leading to gonadal regression. Light duration and intensity play an important part in the regulation and control of production, reproduction, behaviour, and welfare of poultry [4, 5]. One of the most important physiological effects of long day length is to stimulate gonadal growth and increase plasma sex steroids by stimulating gonadotrophin production and release. Therefore, long photoperiods stimulate sexual maturation whereas short photoperiods inhibit or delay sexual maturation [6-8].

Quails are the only species known to show the obligate relative photorefractoriness. Song sparrows [9] and house sparrows [10] eventually become photorefractory during exposure to long photoperiods but timing can vary widely between individuals. In quail, sexual development is known to depend on the length of the daily light period. Long photoperiods stimulate sexual maturation, while short photoperiods inhibit or delay sexual maturation [6, 8]. It has been reported that hypothalaminc –pituitary – adrenocortical axis is activated by stress and increase plasma corticosterone concentration in poultry [11].

The aim of this study was to investigate the effects of a continuous lighting schedules (LL) versus a normal day light (NDL) on the growth, food consumption, sexual maturity and breeding biology of Japanese quails (*Coturnix coturnix japonica*).

MATERIALS AND METHODS

Quail eggs were procured from Central Avian Research Institute, Izatnagar (U.P.) and hatching was done in Imphal. After hatching the pullets were brought to departmental laboratory at Manipur University (Latitude 24.82^{0}N and Longitude 93.95^{0}N) and divided into groups (12 birds each) having almost equal body weight using a single top pan balance. Then they were transferred into photoperiod chambers. The birds were fed with known feed stuff and reared together upto3rd week. After 3rd week, the birds were divided into pairs (one male and one female) upto the end of the experiment in both LL and NDL. Observations on food intake, body weight, sexual maturity and egg laying were recorded. The total number of eggs and volume of eggs was also recorded. Volume of eggs was recorded by using Bissonnets formula $4/3\pi ab^2$ given by Thapliyal [12]. The body weight and food consumption values were expressed on M ± SE. Statistical analysis was done by using ANOVA followed by Tukeys multiple comparisons test (P<0.05 were considered as significant). Meteorological report was collected from ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal. The experiment was conducted for 90 days. The same experiment was repeated during early summer, summer and winter.

RESULT

Early summer: During early summer, the body weight of the adult birds of LL increases significantly (P<0.05) compared to NDL 258.00 ± 15.55, 218.98 ±2.75 gms/bird. Food consumption value in grams/bird was also higher in LL group than NDL (17.49 ± 0.61, 11.60±0.22gms/bird), Table 1.1. Egg laying in LL commenced from 58th day from the 1st day of rearing. Volume of eggs ranged from 9.45mm^3 to 12.93 mm^3 and total number of eggs were 83(n=3♀'s), Table 2.1. Whereas in NDL there was no egg laying by the females. During the study period, mean maximum temperature was 25.98^{0}C to 33^{0}C and minimum temperature was 19.7^{0}C to 23.17^{0}C, Fig. 1(a). Weekly mean sunshine ranged from 0.94 hrs to 5.47 hours.

Table 1.1 Body Weight And Food Consumption In Early Summer

No. of Weeks	NDL		LL	
	Body Weight (in gms)	Food Consumption (in gms)	Body Weight (in gms)	Food Consumption (in gms)
1st	15.90±0.57	1.49±0.34	16.67±0.54	1.93±0.47
2nd	39.88±1.69	5.59±0.80	41.89±1.43	7.04±1.01
3rd	82.65±3.26	9.53±0.62	73.50±7.65	9.96±0.93
4th	135.75±1.65	13.25±0.56	129.83±7.65	13.42±0.93
5th	163.00±2.40	12.92±0.35	175.19±9.9	15.76±0.21
6th	180.01±2.20	12.44±0.23	196.45±9.23	17.01±0.40
7th	189.31±3.19	13.64±0.71	210.90±11.25	14.48±0.59

8th	196.43±2.18	14.01±0.75	230.80±12.89	20.37±0.52
9th	198.71±2.40	12.78±12.30	242.23±14.04	21.02±0.34
10th	208.06±2.20	12.61±0.36	249.40±14.93	19.14±0.29
11th	213.91±2.07	12.88±0.19	252.89±15.33	19.43±0.54
12th	218.82±3.0	13.22±0.28	254.89±14.63	16.38±0.82
13th	218.98±2.75	11.60±0.22	258.00±15.55	17.49±0.61

*values Are Mean Of Six Replicates

Table 2.1 Eggs Collected During Early Summer (4/3πab2) In Ll

Sl. no. of eggs	Volume of Eggs (in mm3)	Sl. no. of eggs	Volume of Eggs (in mm3)	Sl. no. of eggs	Volume of Eggs (in mm3)
1.	8.71	30.	12.55	59.	10.93
2.	10.11	31.	12.93	60.	11.29
3.	10.76	32.	12.93	61.	9.02
4.	11.29	33.	12.93	62.	9.02
5.	11.29	34.	12.93	63.	10.11
6.	11.29	35.	12.55	64.	10.11
7.	10.43	36.	11.64	65.	10.11
8.	10.43	37.	14.32	66.	10.11
9.	10.43	38.	13.91	67.	10.11
10.	11.29	39.	14.32	68.	10.11
11.	11.64	40.	12.93	69.	13.50
12.	12.17	41.	9.45	70.	12.55
13.	11.29	42.	9.02	71.	13.91
14.	11.29	43.	9.78	72.	13.91
15.	11.65	44.	9.45	73.	13.91
16.	11.29	45.	10.11	74.	11.29
17.	11.29	46.	9.45	75.	11.64
18.	11.29	47.	10.11	76.	11.29
19.	9.78	48.	10.11	77.	11.29
20.	9.02	49.	10.93	78.	10.93
21.	11.79	50.	10.11	79.	11.29
22.	13.19	51.	10.11	80.	11.29
23.	13.31	52.	10.11	81.	10.93
24.	13.31	53.	11.92	82.	11.29
25.	13.31	54.	10.93	83.	10.11
26.	12.55	55.	10.93	Total	=83
27.	11.64	56.	10.93		
28.	14.48	57.	11.29		
29.	8.71	58.	10.93		

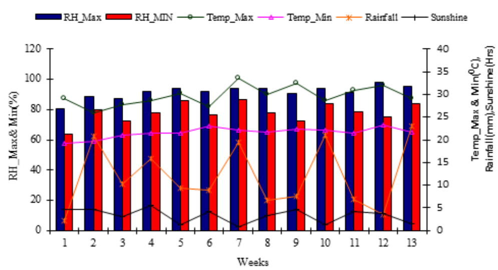

Fig. 1(a) Diagrammatic Representation, Early Summer

SOURCE

Statistical Report ICAR, Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal

SUMMER

In summer the average mean body weights of birds in NDL and LL showed significant difference (243.97 ±20.04, 241.80 ± 11.01gm/bird, Table 1.2. Food consumption value was higher in LL compared to NDL group (17.20 ±0.42, 12.14 ±0.44 gms/bird). Egg laying in LL starts from 53rd day but in NDL there was no egg laying by the females. Total numbers of egg were 92 (n=3, ♀'s). Volume of egg ranged from 9.02mm3 to 12.93mm3, Table 2.2. During the study period, mean maximum temperature varied from 28.30C to 33.210C, mean rainfall was higher in 5th week (23.55mm) and minimum was recorded in 9th week (0.34mm). Average sunshine varied from 1.54 hrs to 5.68hrs. Fig. 1 (b).

Table 1.2 Body Weight And Food Consumption In Summer

No. of Weeks	NDL		LL	
	Body Weight (in gms)	Food Consumption (in gms)	Body Weight (in gms)	Food Consumption (in gms)
1st	17.72±1.01	1.94±0.30	15.65±2.23	1.99±0.25
2nd	51.98±2.44	7.04±0.77	45.17±1.82	6.56±0.60
3rd	97.95±5.99	11.88±0.44	81.00±2.53	9.95±0.30
4th	147.16±11.48	13.74±0.82	131.21±6.22	13.76±0.98
5th	184.83±12.44	14.32±0.33	167.89±6.66	15.29±0.25
6th	205.70±13.88	12.36±0.31	186.33±11.09	15.89±0.88
7th	209.50±13.30	12.89±0.23	207.89±12.88	18.55±0.28
8th	212.18±12.00	13.74±0.43	222.06±12.61	20.71±0.64
9th	225.66±14.36	13.88±0.44	232.69±12.87	18.50±0.64
10th	232.26±16.39	13.40±0.23	228.57±10.39	17.89±0.42
11th	236.73±13.93	13.93±1.37	231.40±13.87	17.59±0.53
12th	241.81±19.32	13.87±0.48	237.13±13.40	18.16±0.33
13th	243.97±20.04	12.14±0.44	241.80±11.01	17.20±0.42

*values Are Mean Of Six Replicates

Table 2.2 Eggs Collected During Summer (4/3πab2) In Ll

Sl. no. of eggs	Volume of Eggs (in mm3)	Sl. no. of eggs	Volume of Eggs (in mm3)	Sl. no. of eggs	Volume of Eggs (in mm3)
1.	10.11	33.	10.93	65.	11.64
2.	10.43	34.	11.29	66.	12.93
3.	10.43	35.	11.29	67.	10.43
4.	10.43	36.	9.78	68.	10.76
5.	10.11	37.	10.11	69.	10.76
6.	16.04	38.	10.11	70.	10.11
7.	9.92	39.	10.11	71.	11.29
8.	11.99	40.	10.11	72.	9.78
9.	11.99	41.	9.02	73.	9.78
10.	11.64	42.	9.02	74.	8.71
11.	11.64	43.	9.02	75.	9.78
12.	10.43	44.	9.02	76.	10.43
13.	10.43	45.	10.11	77.	10.43
14.	10.76	46.	10.11	78.	9.78
15.	11.64	47.	10.43	79.	10.93
16.	11.29	48.	10.43	80.	10.43
17.	10.76	49.	10.43	81.	10.43
18.	11.29	50.	10.43	82.	9.32
19.	10.43	51.	9.32	83.	10.43
20.	10.43	52.	10.43	84.	10.11
21.	9.78	53.	10.43	85.	10.43
22.	10.11	54.	10.11	86.	10.43
23.	10.93	55.	10.43	87.	9.32
24.	11.29	56.	9.32	88.	10.11
25.	10.93	57.	10.76	89.	10.43
26.	9.78	58.	10.43	90.	10.43
27.	10.11	59.	10.43	91.	10.43
28.	10.11	60.	10.43	92.	10.11
29.	9.78	61.	11.64	Total	=92
30.	9.78	62.	11.64		
31.	9.78	63.	12.55		
32.	11.29	64.	11.64		

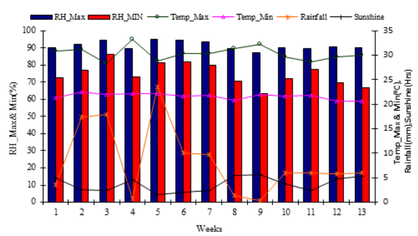

Fig. 1(b) Diagrammatic Representation, Summer

Source: Statistical Report ICAR, Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal

Winter: In winter season average mean body weight of birds in LL increased significantly (P<0.05) compared to the birds in the NDL during the 90 days of rearing period (245.95±10.43, 224.53±12.06 gms/bird). Food consumption was also higher in LL group than NDL group (17.80±0.55, 14.08±0.35gms/bird), Table 1.3. Commencement of egg laying started from 54^{th} day of rearing. But in winter season egg laying was noticed in NDL in 84^{th} day and total number of eggs was 5(n=3, ♀'s) however in LL, total number of eggs were 94, Table 2.3 and 2.4. Volume of eggs in both LL and NDL ranges from 9.78mm^3 to 12.55mm^3. During the study period, mean maximum temperature was recorded in 11^{th} week, 26.7^{0}C and minimum temperature was recorded in 8^{th} week, 1.3^{0}C. No rainfall was recorded in first fourth week and from 8^{th} to 12^{th} week. Weekly sunshine was more or less similar, Fig. 1©.

Table 1.3 Body Weight And Food Consumption In Winter

No. of Weeks	NDL		LL	
	Body Weight (in gms)	Food Consumption (in gms)	Body Weight (in gms)	Food Consumption (in gms)
1st	10.81±0.42	1.04±0.12	12.14±0.50	1.45±0.26
2nd	30.77±1.59	2.36±0.52	33.27±1.27	4.95±0.82
3rd	84.24±2.20	8.05±0.98	87.86±1.89	10.41±0.69
4th	116.39±6.25	14.79±1.08	138.18±4.46	14.31±1.03
5th	125.58±5.65	18.23±0.64	180.77±5.64	18.66±0.56
6th	186.83±6.41	17.07±0.35	206.95±7.35	20.03±0.63
7th	197.97±7.07	16.81±0.25	227.91±8.85	18.07±0.94
8th	203.08±7.02	17.47±0.27	234.30±8.10	18.23±0.77
9th	206.78±8.63	16.39±0.20	231.60±8.19	18.60±0.41
10th	205.79±6.61	14.58±0.58	240.45±8.15	18.49±0.39
11th	213.13±24.88	13.36±0.27	244.48±8.72	18.34±0.32
12th	218.66±10.44	15.24±0.55	246.68±8.46	18.01±0.55
13th	224.53±12.06	14.08±0.35	245.95±10.43	17.80±0.55

*Values are mean of six replicates

Table 2.3 Eggs Collected During Winter (4/3πab^2) In Ll

Sl. no. of eggs	Volume of Eggs (in mm3)	Sl. no. of eggs	Volume of Eggs (in mm3)	Sl. no. of eggs	Volume of Eggs (in mm3)
1.	10.11	33.	11.29	65.	11.29
2.	9.78	34.	11.29	66.	11.29
3.	11.29	35.	12.17	67.	10.93
4.	11.64	36.	9.78	68.	10.93
5.	12.55	37.	11.29	69.	10.93
6.	11.64	38.	11.64	70.	11.29
7.	11.29	39.	11.64	71.	11.29
8.	10.11	40.	12.55	72.	11.29
9.	10.11	41.	11.64	73.	11.29
10.	10.11	42.	12.55	74.	10.93
11.	9.78	43.	12.55	75.	11.29
12.	9.78	44.	12.55	76.	11.29
13.	10.11	45.	10.11	77.	12.17
14.	9.78	46.	10.11	78.	11.29
15.	11.29	47.	11.64	79.	11.29
16.	10.58	48.	10.11	80.	11.64
17.	10.11	49.	10.11	81.	11.29
18.	11.29	50.	10.43	82.	11.29
19.	10.43	51.	10.11	83.	12.55
20.	11.29	52.	11.29	84.	11.29
21.	11.29	53.	10.43	85.	11.64
22.	10.58	54.	10.11	86.	10.42
23.	9.78	55.	10.43	87.	11.64
24.	9.78	56.	10.11	88.	11.29
25.	9.78	57.	11.29	89.	11.29
26.	9.78	58.	11.29	90.	9.78
27.	10.11	59.	10.11	91.	11.64
28.	9.78	60.	10.43	92.	11.64
29.	9.78	61.	11.29	93.	11.64
30.	10.11	62.	11.29	94.	11.64
31.	10.68	63.	11.29	Total	=94
32.	10.68	64.	10.42		

Table 2.4 Eggs Collected During Winter (4/3πab^2) In Ndl

Sl. no. of eggs	Volume of Eggs (in mm3)
1.	9.78
2.	10.43
3.	10.43
4.	11.64
5.	10.43
Total	=5

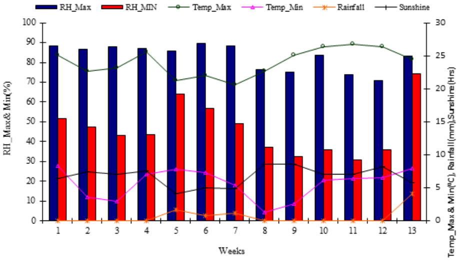

Fig. 1(C) Diagrammatic Representation, Winter

Source: Statistical Report ICAR, Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal

DISCUSSION

Photoperiod is considered as an important management tool to manipulate reproductive behaviour and performance in poultry. The result in this study indicates that the final body weight of birds in LL was significantly higher than those NDL (Table 1.1, 1.2, 1.3). It appears that LL group birds benefited from the longer feeding time during the period of rapid growth. Quail from the LL group reached earlier maturity at an earlier age than the NDL group. An explanation for these observation may be with regard to increase in day length during the period of experiment when compare to the natural day length which range from 10 to 13½ hrs regardless of season in Manipur.

Various aspects of quail behaviour are influenced by photoperiod. Another explanation is that, it is possible that the birds on the LL treatment could sense cues from the environment, mostly available from outside. While the NDL birds were subjected to very strong signal of onset of darkness and onset of day. This would retard the sexual development of the birds exposed to NDL treatment compare to the LL group. The present work also supports the finding of Boon *et. al.,* [6] that long photoperiods stimulate sexual maturation whereas short photoperiods inhibit or delay sexual maturation. The present finding also agrees with the works [6, 7] where photoperiod can also influence weight gain via an effect on the balance between food intake and digestion [12]. Food intake occurs throughout the light period, whereas during the dark period when food intake and activity are suppressed, digestion can continue. Sexual maturity can be delayed by the use of step down light regiment (declining photoperiod) during the growing pullets [13].The present study clearly reflects that Japanese quail is a photoperiodic animal.

CONCLUSION

The results in this study indicate that the body weight and food consumption of LL (Continuous light) group was higher than the NDL (Normal day length) groups. Quail from the LL group reached sexual maturity at an earlier age than the NDL groups. The result of this study could provide a significant economic consideration for producers of quail eggs and meat.

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