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The Effect of Ahemeral Light-Dark Regimes on Plasma Luteinizing Hormone (LH) of Domestic Hens

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It is aimed to follow plasma LH peak under 23, 28 and 30 hr light dark cycles also to find out when ovulation occurs under 23 and 28 hr cycles. Two experiments were carried out. Each experiment involved two light-dark regimes. White Leghorn hens were housed individually in separate rooms. The light dark regimes of the first experiment were 14 L : 9 D and 14 L : 14 D and of the second experiment were 14 L : 1 [illegible] and 14 L : 16 D. Blood samples were collected at hourly intervals [illegible] at 9 or 6 hr. before expected ovulations. LH was measured by radioimmunoassay. Hens were slaughtered at fixed time after ovipositions to observe the ovulated yolk. It was found that 50% of the hens ovulated at 22 or 100 min after oviposition under 23 and 28 hr light dark cycles respectively. Plasma LH peak preceded ovulation by 4 to 5 hr. Plasma LH peak displaced by about 6 hr under 30 hr light dark cycles.

Previous studies were performed regarding the effect of light and dark cycles on both the egg laying pattern and timing of oviposition in hens. The pattern of oviposition can be entrained readily to ahemeral light dark cycles (non 24 hr cycles) ranging from 21 to 30 hr (Biellier and Ostmann, 1960 and Harrison and Becker, 1969). None of these studies gives direct information about the time of ovulation under ahemeral cycles. The mean interval between oviposition and the associated ovulation for hens which were maintained under 24, 27 or 30 hr cycles was stated to be 24 or 30, 36 and 130 min respectively (Warren and Scott, 1935, Phillips and Warren, 1937 Melek, Morris, and Jennings, 1973 and Abdelrazik, 1977). None of these reports gives information about the interval between oviposition and associated ovulation under ahemeral light-dark cycles shorter than 24 hr.

The release of LH from the anterior pituitary is under neuroendocrine mechanism (Fraps, 1955 and 1961) which resulted in ovulation within a period of about 8 hr in each solar day. A single peak of plasma LH occurs 4 to 7hr before ovulations in hens exposed to photoperiodic regime of 14 hr light and 10 hr dark (14 L : 10 D) or of 14 L : 13 D (Cunningham and Furr, 1972 ; Furr, Bonney, England and Cunningham, 1973 ; Senior and Cunningha m,

1973 and 1974, Wilson and Sharp, 1973 ; Morris, Malek andCunningham, 1975 and Etches and Cunningham, 1977). One wonders when plasma LH peak occurs under ahemeral light dark cycles shorter than 24 hr or longer than 27 hr.

Anaylsis records of oviposition time (Unpublished date) of hens kept under 23, 24, 28 and 30 hr light dark cycles show some interesting points. No real differences were observed between either the intra or the inter clutch interval for hens maintained under 23 and 24 hr light dark cycles. The interval between consecutive ovipositions under 28 or 30 hr light-dark cycles are almost 28 and 30 hr. respectively compared with a value of about 25 hr for high producing pullets kept under 14 L : 10 D cycles. Thus, there is a difference between 24 hr light dark cycles and 28 or 30 hr. light-dark cycles of 3 to 5 hr in the interval between consecutive ovipositions. At this point, more information is needed about the relationship between the ovulatory events under ahemeral cycles shorter and longer than 24 hr light dark cycles. The aim of the present work is to investigate when both plasma LH peak and ovulations occur under ahemeral light dark cycles of 23, 28 and 30 hr.

Material and Methods

The present research included two experiments each involved two groups of hens. White Leghorn hens during the end of the first year of age were housed individually in light proof separate rooms. Diet and water were available all the time. Oviposition times were recorded automatically to the nearest minute. The hens were kept under the experimental light dark treatments till they adapted to them as judged from their oviposition records and then the experimental data were obtained. The first experiment : To follow plasma LH peak one group of hens was maintained under 14 L : 9 D cycles and the other group was maintained under 14 L : 14 D cycles. Fourteen hens from each treatment were sampled. To know when ovulation occurs ten hens from each treatment were killed at each fixed time after oviposition (Fig. 1). The birds were killed by injection of over dose of sodium pentobarbitone into the wing vein. The second experiment : To follow plasma LH peak one group of hens was maintained under 14 L : 16 D cycles. Blood samples were collected from fourteen hens before four consecutive ovulations. The other group received 14 L : 10 D cycles and ovipsition time was observed. Two weeks after the last blood collection, hens received 14 L : 16 D cycles were used to synchronize the ovulatory events to be typical of 24 hr light dark cycles. Subcutaneous injections (s.c.) of synthetic mammalian like luteinizing hormone-releasing hormone (LH - RH) in 0.2 ml 0.9% saline solution were performed at 18 hr after three consecutive ovipositions. Oviposition time was used as an indicator to the previous ovulatory events. Induced and uninduced eggs were weighed (Table 2). Blood samples (one ml) were collected from the branhial vein of individual hen into one ml heparinized syringes to follow LH peak before ovulations. Blood samples were collected at hourly intervals beginning at 6 to 9 hr before the expected time of ovulation. The

samples were cooled in ice and centrifuged within 10 min for 20 min at 1500 g. Plasma was separated and preserved at —20° till assay. LH was assayed by radiommunoassay method described by Follett, Scanes and Cunningham (1972) with the modification adopted by Abdelrazik (1977). Observations from individual birds were pooled in relation to the time of ovulation.

Results

Ovulation time

Figure 1 shows that pullets maintained under 14 L : 9 D ovulated after ovipositions. Half of the pullets ovulated at about 22 min after ovipositions. Pullets received 14L: ovulated after oviposition with the mean value occurred at about 100 min.

Plasma LH peak

Plasma LH peak (mean pooled values) of pullets which were maintained under 23, 28 and 30 hr light-dark cycles are shown on Fig. 2 and 3. The highest plasma LH values measured preceded ovulation by 4 to 5 hr under these ahemeral light dark cycles. Fig. 3. shows that plasma LH peak under 14 L : 16 D cycles was displaced by about 6 hr each day.

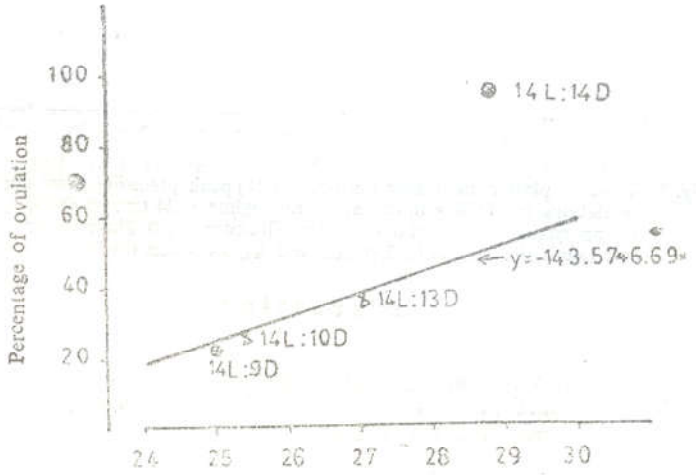

Fig. 1. Percentages of ovulations at fixed intervals after ovipositions of pullets maintained under two ahemeral light dark cycles.

Induced eggs with synthetic mammalian like LH — RH

Table 1 indicates that the mean interval between each two induced successive ovipositions for pullets under 30 hr regime is almost like the natural intra clutch intervals for pullets under 24 hr regime. The weight of the induced eggs under 30 hr light-dark cycles was nearly the same as the weight of the normal uninduced eggs under 24 hr light-dark cycles (Table 2).

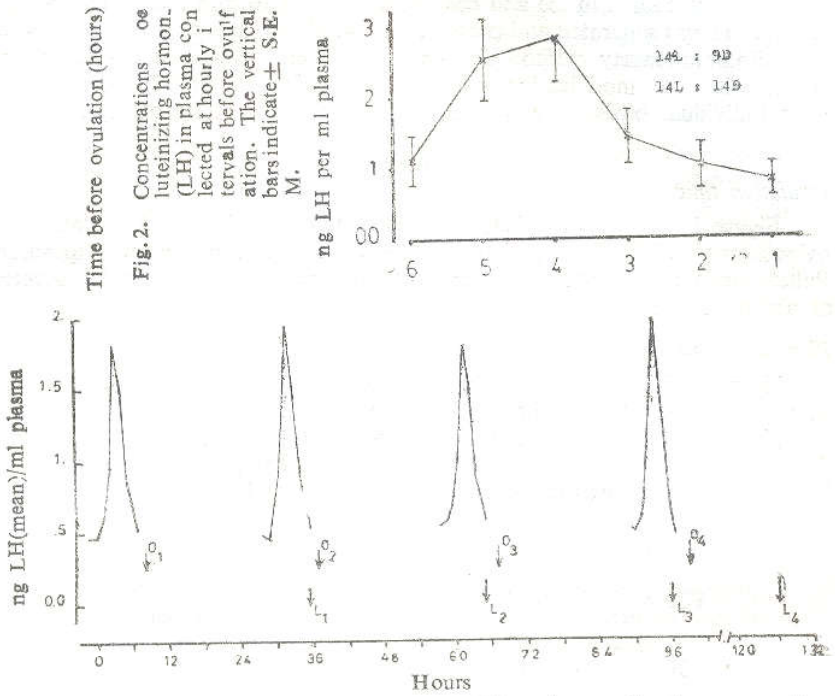

Fig. 2. Concentrations of luteinizing hormone (LH) in plasma collected at hourly intervals before ovulation. The vertical bars indicate ± S.E. M.

Fig. 3. Time of plasma luteinizing hormone (LH) peak preceding four consecutive ovulations for pullets under ahemeral regime of 14 L; 16D, $O_1O_2O_3$ and O_4 are approximate times of ovulatins which occur about 2hours after oviposition (Abdel-Razik 1977), $L_1L_2L_3$ and L_4 are exact times of ovipositions.

Discussion

Ovulation time

In concern with the interval from oviposition to ovulation, Malek *et al.* (1973) who maintained pullets under 24 and 27 hr light dark cycles, used data of Phillips and Warren (1937), who used 24 hr light dark cycles and obtained

$Y = -143.57 + 6.69\ X.$

Y = interval from oviposition to ovulation (minutes).

X = mean intra — clutch interval between ovipositions (hours).

Figure 4 is obtained by using this equation. Data obtained with 14 L : 9 D of the present work coincide with data of Fig. 4 and this may be because intra-clutch intervals did not differ substantially under cycles length ranged from 21 to 27 hr (Unpublished data). Data reported under 14 L : 14 D of the present work deviated from the regression line. This deviation may be because the equation based on limited data of Philips and Warren (1938) or may be because the relationship between the interval from oviposition to ovulation and the intra clutch interval exists under cycles length of 23 to 27

hr only. One may attribute the difference between the interval from oviposition to ovulation under 23 and 28 hr cycles to differences in rate of lay as Malek *et al.* (1973) suggested early. But rate of lay of this work was recorded to be 72.1 and 71.7 under 23 and 28 hr cycles respectively. The differences may be due to pattern of lay since percentage of laying in 8 hr model was found to be 82 and 96 under 23 and 28 hr light-dark cycles respeotively.

TABLE 1. The mean interval (hours) between successive ovipositions of pullets maintained under 14 L: 10 D and 14 L: 16 D* regimes.

Cycle (hours)	Inteval (m ± s.e.m)		
	L_2—L_3**	L_2—L_3	L_3—L_4
14 L : 10 D	25.4±.62	24.8±.79	26.2±.81
14 L : 16 D+	26.5±.83	25.8±.28	26.3±.49

* Ovulation induced under 14 L:16 D regime with s.c. injection of LH-RH at about 8 hr after oviposition.** L^3—L_2 interval between ovipositions of eggs 1 and 2 .. etc.

TABLE 2. The weight of eggs of pullets + maintained under 14 L. 16 D and 14 L: 10 D regime.

14 L: 16 D regime		14 L: 10 D regime
Mean weight (g ± s.e. m) of Uninduced eggs	induced eggs	mean weight (g ± s.e.m) of uninduced eggs
66.4±.98	61.2±1.17	60.2±1.33

±The number of pullets in each treatment was 14 birds.

Plasma LH peak

The interval from LH peak to oviposition under 23, 28 and 30 hr cycles was found o be 4, 3 and 3 hr respectively and by adding the corresponding interval from oviposition to ovulation (Fig. 1 and Abdelrazik, 1977), then LH peak preceded ensuring ovulation by 4 to 5 hr. This assessment agrees with results obtained with pullets maintained under 14 L : 10 D and 14 L : 13 D. cycles (Cunningham and Furr, 1972, Furr, Bonney, England and Cunningham, 1973 ; Senior and Cunningham, 1973 and 1974 ; Wilson and Sharp, 1973 ; Morris *et al.*, 1975 and Abdelrazik, 1977). It is noteworthy that LH peaks re-occur at 30 hr under 14 L : 16 D cycles.

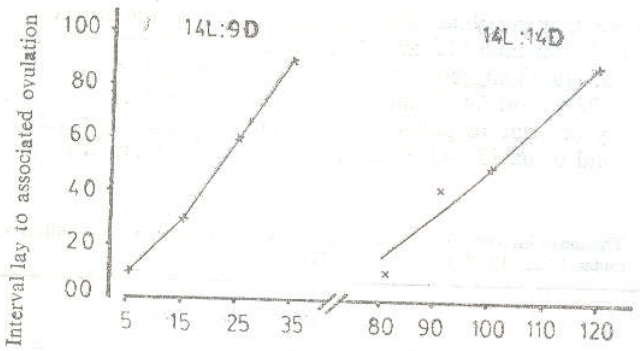

Fig. 4. The relationship between the interval from lay to ovulation and the mean intra- clutch interval. The regression line draw according to Phillips and Warren (1937) dateX date of the present work. data of Melek *et al.*(1973) with 24 (14L:10!) and 27 (14 L:-130) hr light dark cycles.

By comparing the weight of the induced and uninduced eggs indicates that yolk became mature and waited about 2 hr after oviposition (Abdelrazik, 1977) till permission for ovulation. Thus light dark cycles geeres an endogenous rhythm which control the open period and subsequently LH release.

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تأثير نظام اضاءة واظلام غير عادى (ليس ٢٤ ساعة اضاءة واظلام) على هرمون التبويض فى الدجاج

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الغرض من التجارب هو متابعة هرمون التبويض تحت نظم اضاءة غير عادية ومعرفة مدى تأثير نظم الاضاءة هذه على وقت افراز أعلى مستوى لهرمون التبويض ٠

استعملت دجاجات لجهورن فى نهاية عامها الأول ، أجريت تجربتين كل تجربة تشمل معاملتين ضوئيتين مختلفتين كالآتى :

(أ) التجربة الأولى وتشمل :

١ ـ ١٤ ساعة اضاءة + ٩ ساعة اظلام ،
٢ ـ ١٤ ساعة اضاءة + ١٤ ساعة اظلام ٠

(ب) التجربة الثانية :

٩ ـ ١٤ ساعة اضاءة + ١٠ ساعة اظلام ،
٢ ـ ١٤ ساعة اضاءة + ١٦ ساعة اظلام ٠

قتلت دجاجات من التى تعرضت لـ ٢٣ و ٢٨ ساعة اضاءة واظلام بعد أوقات محددة من وضع البيض ٠٠ جمعت عينات دم من الدجاج التى تعرض لدورات ٢٣ و ٢٨ و ٣٠ ساعة اضاءة واظلام وذلك كل ساعة ابتداء من ٦ الى ٩ ساعات قبل الميعاد المتوقع لعدد أربعة تبويضات متتالية ٠

وجد أن ٥٠٪ من الدجاجات قد حدث لها تبويض بعد ٢٢ أو ١٠٠ دقيقة عندما تعرضت لدورات ٢٣ و ٢٨ ساعة اضاءة واظلام على التوالى ٠

وجد أن أعلى قيمة لهرمون التبويض تسبق التبويض بحوالى ٤ الى ٥ ساعة أن ميعاد توقيت أعلى قيمة لهرمون التبويض يتغير بمقدار ٦ ساعة كل يوم عندما وضعت الدجاجات تحت ٣٠ ساعة اضاءة واظلام ٠