2 *Egypt. J. Anim. Prod.* **24**, No. 1-2, pp. 13-21 (1984)

Effect of Different Environmental Conditions on Some Performance Measurements in Fayoumi Layers

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FEED consumption, egg number, egg production percentage, weight of egg produced, average egg weight and average shell weight showed higher values in the artificially lighted group than both the control (normal environmental conditions) and high constant temperature groups. The equal length of light and dark periods (12hr for each) and the intensity of light more than 10 lux may be responsible for the higher egg production in the artificially lighted group. High constant temperature reduced all performance traits studied especially weight of egg produced and number of eggs laid. The stimulating effect of light on increasing egg production is limited in Egypt due to the high air temperature accompanied the period of long days.

Today's laying hens are marvelous machines for converting feed and water into eggs. A good hen (with proper care) will consume about 40-43 kg of feed in 12 months of egg production. For that feed and 60 liters of water she will lay approximately 240 eggs. At an average weight of 680 g per dozen this is 13·6 kg or over 6 times the body weight of the hen. This is truly a remarkable feat. To do this, however, the hen must have good management, including housing, feeding, sanitation, disease prevention, predator control, parasite control and proper disposal of wastes and dead carcasses.

Kruger and Stephan (1963) found that the best production was obtained by lighting daily from 10 to 14 hr (average 12 hr). Bell and Moreng (1973) showed that 24 hr continuous light did not affect egg production, but intermittent light resulled in a significant increase in average egg weight of 1·5 and 1·9 g in two experiments. Echevarria *et al.* (1962) demonstrated that using artificial light increased the production of White Leghorns, Rhode Island Reds and New Hampshires by 9% than controls. Wilson (1964) mentioned that temperatures in excess of 21.1°often reduce egg size, resulting in cash losses to producer. Shell thickness also is reduced by these temperatures, which results in excessive breakage and loss. Fortunately, layers tend to adjust to such high temperature conditions. Ensminger (1980) mentioned that artificial light in the laying house should give a 16-hour day. If natural daylight is longer, artificial light should maintain the longest daylight period, although a light regimen in excess of 17 hr is of doubtful value. North (1981) reported that at temperatures above 27° laying pullets begin to suffer, and the cost of producing market eggs increases. At 38° things become serious. Egg production drops drastically, and many birds may die from heat exhaustion.

Material and Methods

Birds and feeding

Thirty Fayoumi hens which had been in lay for about three months were randomly divided into three equal groups. The layers were housed individually in wire laying cages.

The birds were fed laying ration according to NAS-NRC in (1977). Feed was available for the birds ad libitum, the actual consumption of each hen was calculated. The formula of the ration fed was as follows :

Corn	50·0%
Wheat bran	20·0%
Corn gluten feed	9·0%
Cottonseed meal, dehulled	10·0%
Fish meal	5·0%
Limestone, ground	5·5%
Mineralized salt	0·5%

* Laying hen vitamin premix was mixed with the ration according to the manufacturer "Pfizer" recommendations.

Crude protein and ether extract of the ration were estimated according to A.O.A.C. in (1975), phosphorus was determined after Fiske and Subbarow (1925), calcium and magnesium were analysed using Campell (1957) procedure. Values of ration chemical analysis were as follows :

Crude protein	19·80%
Ether extract	3·83%
Calcium	2·76%
Phosphorus	0·89%
Magnesium	0·20%

The birds were allowed two weeks in the individual laying cages to adapt the new conditions and ration prior tot he begining of the experiment.

Experimental treatments

The first group "control one" was housed in the normal environmental conditions. The second group was confined in a light proof room. The day light was prevented from entering the room which was illuminated by a white fluorescent lights. A lighting regime of 12 hr daily was maintained in the room from 6 a.m. to 6 p.m. The third group was located in a room under constant temperature of 35° throughout the experimental period using thermostatic controlled electric heaters. Source of illumination was only light. Egg production and weight were recorded daily for each hen of the three groups.

The experimental periods

The duration of the experiment was 112 days (16 weeks) which commenced on Feb., 9 and continued until May, 31. This period was divided into 4 subperiods each of four weeks. Normal air temperatures and day length values during the experimental periods are listed below :

Period and date	Air temperature	Average day length
1· Feb.,2 - March,8	14·8° Max., 21 - Min., 8·6)	11 hr, 10 min
2· March,9-April,5	18·3° Max., 24·8 - Min., 11·8)	11 hr, 46 min
3· April,6-May,3	22·1° (Max., 39·6 - Min., 14·6)	13 hr, 11 min
4· May,4-May,31	23·5° Max., 31·4 - Min., 15·7)	14· hr, 1 min
Mean of the overall experiment	19·7° (Max., 26·6 - Min., 12·7)	12 hr, 32 min

Statistical analysis was conducted after Snedecor (1959).

Results and Discussion

I· Hen performance measurements

Table 1 shows noticeable differences in over-all hen performance measurements studied between the control group and the other two. Applying "t" distribution, it was found that the aforementioned differences were statistically significant.

TABLE 1. Hen performance measurements under the different experimental conditions.

Criteria	Experimental conditions		
	Normal environm-ental conditions	Artificial light	High constant temperature
Feed consumption (g)	7551±226	8926±217	6080±245
Daily feed consumption (g)	67±2.02	80±1.95	54±2.19
Egg number	48.6±2.73	55.8±2.47	45.4±2.29
Percentage of egg production	43.3±2.44	51.6±2.21	31.6±2.04
Weight of egg produced (g)	1951±115	2449±109	1373±92
Average egg weight (g)	40.1±0.50	42.4±0.56	38.8±0.72
Average shell wegiht (g)	4.54±0.07	4.74±0.06	4.26±0.11

* Standard error.

** Data are on hen basis.

Artificial light treatment increased all the items studied over the control. The highest increase was in the weight of egg produced (25·48%) followed by that of feed consumption (18·21%), egg number (19·83%) average egg weight (5·61%) and average shell weight (4·41%). The percentage increase in egg production was accomplished with almost identical value of increase in feed consumption.

Although the increases in egg production and feed consumption were nearly of the same percentage in this work, when the increase of feed consumed was divided by the increase in egg weight, it could be noticed that for each 2·77 g of extra feed was required for each g of the extra eggs laid. This may explain the inducing effect of artificial light on increasing egg production through the conversion of feed to eggs. In this connection Black (1965) stated that the light plays a key role in determining the rate of egg prodcution. Light striking the hen's eyes stimulates the pituitary gland, which releases an ovary - stimulating hormones and other hormones into the blood stream, and these hormones cause ovulation. The amount of ovary-stimulating hormones released by the pituitary gland is regulated by the length of time that the birds eye are exposed to light stimulation. Also a gradual increase in day lenght by about 15 min per week to a total of 17-18 hr. day is recommended (North, 1981).

The increment in egg laying may be due also to the fact that, day length was in a cycle with light and dark periods of equal length (12 hr. each). Best production was obtained by a daily lighting period with an average of 12 hr.

(Kruger and Stephan, 1963 and Zhordaniya *et al.*, 1971). The intensity of light in the present work was 11·51 lux, it seems that it was sufficient for proper egg production. Morris and Owen (1966) demonstrated that artificial light not less than 10 lux was adequate for maintaining maximum of lay.

The effect of high constant temperature *i.e.*, 35° was very profound. The decrease in performance from the control "normal environmental conditions" was highest in egg weight (29·63%), followed by egg production (27·16%), feed consumption (19·48%), average egg weight (3·24%) and average shell weight (6·17%). In this connection Wilson (1959) mentioned that temperatures in excess of 21° often reduce egg size, resulting in cash losses to producer. Shell thickness also is reduced by these temperatures, which results in excessive breakage and loss. Fortunately, layers tend to adjust to such high temperature conditons. West Virginia University (1963) cited that extreme temperatures may reduce egg production. It was advised that house temperature should be maintained as close to 12·8° as possible throughout the year, above 4·4° in winter and below 23·9° in summer. The adverse effect of the high temperatur up to 35 ° was also observed by Ito *et al.* (1971), (1972) and Ahmad *et al.* (1967). On the other hand, Sheikh *et al.*, (1974) reported that there was no significant effect on egg production, egg weight, shell thickness and body weight of New Hamsphire and White Cornsih breeds by raising the temperature up to 35°. The reduction in shell weight due to high temperature was in agreement with that found by Smith and Oliver (1972).

II. Periodical variations in performance

Table 2 shows the periodical classification of the data (each of four weeks to illustrats the effect of the change in some environmental factors as day length and air temperature on hen preformance measurements.

In the control group the feed consumption differed between the four periods of the experiment, it was highest in the third period which recorded the highest egg production and mass. The second period recorded the highest average egg weight and the lowest mean of shell weight.

In the case of the artificial light treatment, no appreciable differences in the feed consumption were found between the four periods. This may be attributed to the fixed lighting period (12 hr) throughout the experiment. On the other hand, there were some differences in egg production. These were presented in the highest percentage in egg production in the second period and some increase in both the third and fourth periods. Egg weight was highest in the second period and lowest in the first one. The second period showed the highest mean of egg weight, however, the average shell weight was lower than the other periods.

TABLE 2. Effect of periodical variations on performance measurements of layers under different environmental conditions.

Periods	Feed consumption (g)	Egg number	Percentage of egg production	Weight of egg produced(g)	Average egg weight(g)	Average shell weight(g)
	Normal environmental conditions					
1	1788±61.0	9.4±0.85	33.6±3.04	372±36.2	39.5±0.82	4.91±0.14
2	1876±70.69	12.0±1.23	42.9±4.41	483±52.2	40.1±0.48	4.27±0.11
3	1977±72.77	15.1±0.90	53.9±3.21	601±63.3	39.7±0.66	4.55±0.08
4	1921±64.86	12.1±1.26	43.2±4.51	478±50.1	39.5±0.63	4.43±0.13
	Artficial light					
1	2225±70.90	12.4±1.08	44.3±3.86	533±47.9	42.9±0.56	4.83±0.08
2	2226±60.76	16.0±0.58	57.1±2.08	708±24.5	44.3±0.61	4.31±0.11
3	2222±47.39	14.8±0.73	52.9±2.62	637±34.0	42.8±0.67	4.97±0.09
4	2253±64.24	14.6±0.95	52.2±3.36	574±41.4	39.2±0.67	4.83±0.11
	High Constant temperature					
1	1571±70.90	7.6±0.82	27.1±29.19	302±33.8	39.7±0.81	5.00±0.17
2	1524±72.33	9.7±0.62	34.6±2.21	386±25.5	39.8±0.84	4.18±0.13
3	1586±81.44	11.7±0.86	41.8±3.08	452±35.7	38.7±0.90	4.28±0.15
4	1399±58.58	6.4±0.87	22.9±3.12	233±32.2	36.3±0.73	3.52±0.12

* Standard error.

**Data are on hen basis.

The high constant temperature showed slight difference in feed consumption between the first three periods and a drop in the fourth. The third period recorded the highest egg production. Average egg weight was also higher in the second period and lowest in the fourth. Average shell weight was highest in the first period and lowest with wide difference in the fourth period.

The data of the three treatments showed that the highest egg production was observed in either the second and third periods where air temperature ranged between 22·1 and 18·3° in the control and lighted groups respectively, despite the fact that was constant at 35° in the heat stress group. This may be due to the increased day length in the second and third periods. In the control and lighted groups this air temperature may be the optimum for Fayoumi hens to give maximum production. The study in this concept was supported by the findings of Asoub and Esselden (1966) with the same breed of layers and the same location.

In the second and high temperature groups, gradual and steady increase in performance was shown until the third period. This increase of the increase of the heat stress group was in a lower magnitude than in the control group. It seems that it was due to the continuous prolonged day length from about 11 hr in the first period to about 13 hr. in the third period

Neverthless, the fourth period with 14 hr. daily failed either to give more increase or to maintain performance but vice versa there was a decline with different magnitudes, but it was more pronounced under heat stress. On the other hand Zhordaniva *et al.* (1971) obtained higher egg production with 14 hr light period under moderate air temperature. The stimulating effects of light on increasing egg production is limited in Egypt due to the high air temperature coinciding the period of long days. The high air temperature effect may overcome the inducing effect of light.

The more adverse effect affecting performance in the fourth period under heat stress may be due to the heat burden imposed by temperature more than 35°. This was due to radiation caused by higher temperature outside, in days of Khamasseen stormy, dry and sandy (spells), which frequently occurs through this time of the year (heat waves).

Hens reared under high constant temperature had no opportunity for relief because of the absence of diurnal variations. This was in agreement with results reported by Navaro De Andrade (1976). Sheikh *et al.* (1974) showed that the performance was adversely affected when the air temprature was rasied over 35°. However, Metha and Rajurohit (1972) reported that wide diurnal temperature ranges did not appear to reduce stress imposed by high maximum temperature.

The high constant temperature decreased egg production, shell weight, the effect was more severe in the shell weight of the fourth period, it was 3·52 g compared with 4·43 and 4·83g for the control and the artificial light groups respectively. The reduced effect of high temperature on egg shell weight was confirmed by Ito *et al*. (1971), (1972) and Ahmad *et al*. (1967). Wilson *et al*. (1972) attributed the reduction in feed consumption to the rise of air temperature and consquent decrease of energy needed for egg production. Hens may for a short while overcome energy inadequancy by catabolizing body reserves but finally, the rate of egg production or egg size or both will be reduced. Romijin and Vreugdenhil (1969) considered the decrease in egg weight associated with high temperature to be a water saving mechanism or a mechanism to conserve nitrogen and maintain the nitrogen balance in the bird.

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تأثير الظروف البيئية المختلفة على بعض الصفات الانتاجيــة فى الدجاج الفيومى

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أظهر كل من استهلاك الغذاء ، عدد البيض ، النسبة المئوية لانتاج البيض ، وزن البيض الناتج قيما أعلى فى مجموعة الاضاءة الصناعية عن كلا من مجموعة المقارنة ومجموعة درجة الحرارة المرتفعة • تساوى فترات الاضاءة والاظلام وشدة الضوء أكثر من ١٠ لوكس « وحدة اضاءة » قد يكونا السبب فى الانتاج الأعلى من البيض فى مجموعة الاضاءة الصناعية • خفضت درجة الحرارة المرتفعة من جميع الصفات الانتاجية موضع الدراسة وبصفة خاصة وزن وعدد البيض الناتج• والتأثير المنبه للضوء فى زيادة انتاج البيض يكون محدود المفعول فى مصر بسبب زيادة درجة حرارة الجو المصاحبة للأيام ذات النهار الطويل •