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Effect of fluctuating ambient temperature on the performance of laying hens in the closed poultry house

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Abstract

Experiments were carried out to observe the effect of fluctuating ambient temperature and humidity on the performance of layers inside the closed system. The study was performed at El-najah Poultry Farm (closed system) in the central region in Saudi Arabia. 360 one-day-old layer chicks (Hy-line W98) were distributed randomly into three locations A, B and C in the central floor of the central line (battery) of the rearing house. At the beginning location A, centre location B and at the end of the house location C. Each location consists of 6 replicates (A1–A6, B1–B6 and C1–C6). In each replicate 20 chicks were housed. Pullets were transferred to the production house in the same farm at 17th week in the similar locations mentioned above. Each location consists of 6 replicates. In each replicate 5 birds were weighed and housed. The study revealed that, birds in location B (the centre of the house), where the temperature ranged (14-28°C) and humidity (22-90%), exhibited better performance than the other two locations, A and C, where temperature range (18-30°C, and 20-32°C) respectively, and humidity (30-80%, and 34-84%) respectively. Therefore it was concluded that fluctuation of temperature inside the closed poultry house will affect the performance of laying hens.

Key words: Closed House, Humidity, Layers and Temperature.

Introduction

Poultry producers often try to control factors such as temperature, humidity, light, nutrition, air and sound, to maintain normal physiological functions and produce meat or egg at its maximum rate. Nesheim et al. (1979) reported that, a suitable poultry house will protects birds from extremes of temperature and other unfavourable weather conditions. Temperature is commonly assumed to be the most important environmental factor influencing chicken health, behavior and production (Webster and Czarick, 2000). The authors mentioned that, in a well designed house if the temperature is within a suitable range, the other factors of the layer house environment usually are acceptable as well. Also temperature is important because it affects the feed consumption of birds and so will influence egg size (Emmans and Charles, 1977). If there are variations of temperature according to different locations within the layers closed house, then birds will consume lesser or greater amounts of nutrients than required hence egg size will differ greatly (Webster and Czarick, 2000). The great fluctuation in house temperature during cold weather may lead to poor feed conversion ratio and to health problems (Czarick and Lacy, 1993). There is a little information about the variations of temperature within the layers closed-house and their effects on productive performance of laying hens. However, variations of temperature within the layers closed-house was detected in some farms in Saudi Arabia (KSA), that are using cooling pads in the center of the house with exhaust fans at the borders (quick survey). Although some of these farms tried to overcome this problem by adding more cooling pads and exhaust fans, but still there were variations in different locations inside the house.

Materials and Methods

The experiment was performed at El-najah Poultry Farm (closed system) in the central region in Saudi Arabia. 360 one-day-old layer chicks (Hy-line W98) were distributed randomly into three locations A, B and C in the central floor of the central line (battery) of the rearing house. Inside the house there were five batteries, each consists of three floors (lower, central and upper). Cooling pads (cells) with a length of 25 meters each are located in the centre of the house on both sides of the walls (left and right). The exhaust fans (12) are divided into two similar groups on both sides of the house (front and back, left and right). The first group of chicks was placed at the beginning of the house (location A). The second group was located at the center of the house (location B), and at the end of the house the last group of chicks was placed (location C). The three locations were at the central floor. Each location consists of 6 replicates (A1–A6, B1–B6 and C1-C6). In each replicate 20 chicks were housed. Pullets were transferred to the production house in the same farm at 17th week in the similar locations mentioned above. Each location consists of 6 replicates. In each replicate 5 birds were weighed and housed. Feed was restricted during rearing period according to recommendations of the chick`s producer (Hy-line, 1998-1999). Diets were formulated to meet or exceed (NRC, 1994) requirements of layers (chicks, pullets and hens). According to Arasco (2004) recommendations, chicks were fed on chick starter mash (Table 1) from one day old till the end of week 6. Pullet grower mash (Table 2) from week 7 till the end of week 14. Pullet developer mash (Table 3) from week 15 till the start of production at week 19. When the production was started they were transferred to layer ration (Table 4). Lighting program was performed according to chick`s producer advices (Hy-line, 1998-1999). Parameters recorded were feed consumption, body weight and feed conversion ratio during both rearing and production periods, then egg production, egg weight, egg mass, broken egg, dirty egg and soft eggshell. Routine and occasional management, vaccination and medication were carried out as and when due. The experiment lasted 33 weeks, rearing period 18 weeks and production period 15 weeks. The experiment was performed in a complete randomized block design. Data obtained from the experiment was analyzed by analysis of variance using statistical package SPSS version 10. The significance of differences between means was assessed using Least Significance Difference (LSD) as described by Steel and Torrie (1980).

Table 1: Calculated analysis of chick starter mash

Item	Calculated analysis
Metabolizable energy	2800 Kcal/kg
Crude protein	21% Minimum
Crude fat	2.5% Minimum
Crude fibre	3% Maximum
Calcium	1%
Total phosphorus	0.8%
Methionine	0.45%
Methionine + cystine	0.75%
Lysine	1%

(Arasco, 2004); Ingredients; Cereals, Soya bean meal, Vegetable oil, Amino acids, Vitamins and minerals + Coccidiostat.

Table 2: Calculated analysis of pullet grower mash

Item	Calculated analysis
Metabolizable energy	2700 Kcal/kg
Crude protein	16% Minimum
Crude fat	2.5% Minimum
Crude fibre	4% Maximum
Calcium	1.1%
Total phosphorus	0.7%
Methionine	0.38%
Methionine + cystine	0.65%
Lysine	0.75%

(Arasco, 2004); Ingredients; Cereals, Soya bean meal, Vegetable oil, Amino acids, Vitamins and minerals + Coccidiostat.

Table 3: Calculated analysis of pullet developer mash

Item	Calculated analysis
Metabolizable energy	2700 Kcal/kg
Crude protein	14% Minimum
Crude fat	2.5% Minimum
Crude fibre	4% Maximum
Calcium	1.4%
Total phosphorus	0.6%
Methionine	0.35%
Methionine + cystine	0.55%
Lysine	0.65%

(Arasco, 2004); Ingredients: Cereals, Soya bean meal, Vegetable oil, Amino acids, Vitamins and minerals + Coccidiostat.

Table 4: Calculated analysis of layer ration 17 mash

Item	Calculated analysis
Metabolizable energy	2680 Kcal/kg
Crude protein	17% Minimum
Crude fat	2% Minimum
Crude fibre	3% Maximum
Calcium	4.3%
Total phosphorus	0.65%
Methionine	0.42%
Methionine + cystine	0.7%
Lysine	0.85%

(Arasco, 2004); Ingredients: Cereals, Soya bean meal, Vegetable oil, Amino acids, Vitamins and minerals + Coccidiostat.

Results and Discussion

As shown in Table (5) there was no significant difference ($P \geq 0.05$) between means of feed consumption at different locations. A significant ($P \leq 0.01$) increased in body weight gain and body weight at 17^{th} week and improved feed conversion was obtained by birds at location (B) in the centre of the house, where temperature ranged 14-28°C and relative humidity ranged 22 - 90%. At location (A) at the

Table 5: Performance of Hy-line (W98) layers in the three locations A, B, and C during rearing period (1-17 weeks).

Parameters	Location A	Location B	Location C	LS
Feed consumption (g/bird/day)	46.24±00	46.24±00	46.24±00	NS
Weight gain (g/bird/day)	9.95±3.7 [b]	10.11±2.0 [a]	9.79±1.4 [b]	**
Feed conversion ratio (g feed/g weight)	4.43±.01 [b]	4.36±.01 [a]	4.46±.01 [b]	**
Body weight at 17^{th} week (g)	1221.52±4.6 [b]	1240.62±2.3 [a]	1201.83±1.7 [c]	**

A, B, and C were the three locations at the beginning, center, and end of the house respectively.
a, b, and c = means within the same raw followed by different superscripts are significantly different (P<0.05).
* = significant at (P≤0.05); ** = significant at (P≤0.01); NS = not significance = (P≥0.05); LS = level of significance

Table 6: The productive performance of a Hy-line (W98) layer in the three locations A, B, and C (19-33 weeks)

Parameters	Location A	Location B	Location C	LS
Feed consumption (g/bird/day)	93.72±1.36 [b]	99.1±0.56 [a]	96.36±0.76 [b]	**
Egg production (g/bird/day)	0.82±.05	0.75±0.09	0.79±0.13	NS
Egg production %	82.07±5.0	74.08±9.8	79.00±13.1	NS
Egg weight (g)	54.19±1.2 [b]	56.80±1.7 [a]	53.58±1.9 [b]	**
Feed conversion ratio.(g feed/g egg weight)	2.87±0.48	3.06±0.67	4.07±2.44	NS
Broken eggs (egg/bird/day)	0.09±0.5 [a]	0.07±0.4 [a]	0.18±0.72 [b]	**
Soft shell eggs (egg/bird/day)	0.02±0.14 [a]	0.04±0.38 [b]	0.06±0.36 [c]	**
Body weight at 19 weeks (g)	1395.00±5.5 [b]	1410.33±10.6 [a]	1395.00±5.5 [b]	**
Body weight at 33 weeks (g)	1526.67±39.3 [b]	1615.00±36.7 [a]	1526.67±39.3 [b]	**
Change in body weight from 19-33weeks (g)	1.10±0.32 [c]	1.72±0.3 [a]	1.36±0.25 [b]	**

A, B, and C were the three locations at the beginning, center, and end of the house respectively.
[a-c] means within the same raw followed by different superscripts are significantly different (P<0.05).
* = significant at (P≤0.05); ** = significant at ((P≤0.01); NS = not significance = (P≥0.05); LS = level of significance.

beginning of the house, temperature ranged 14-30°C and relative humidity ranged 30-80%. At location (C) at the end of the house, temperature ranged 13-32 °C and relative humidity ranged 34-84 %.

Table (6) showed that, significantly (P≤0.01) increased feed consumption, body weight at 19 weeks, body weight at 33 weeks and change in body weight (19-33 weeks) recorded by hens at location (B). Also hens at location (B) recorded significantly (P≤0.01) increased egg weight. The possible explanation for the results obtained is the presence of cooling pads in the centre of the house (location B) which increase the relative humidity and at the same time decease temperature in location (B) comparing with other two locations (A) and (C). The results were in line with that of Yahav et al. (2000) and Kuczynski (2002) who stated that, temperature is the main environmental factor influencing chicken health, behavior and production results, and affecting young and older laying hens while the effect of relative humidity is minor. Emmans and Charles (1977) reported that, temperature affects feed consumption which can influence egg size and body weight, and at location (B) lower temperature resulted in increased feed consumption. This result was assured by the findings of Balnave (1998) who noticed that, the effect of high temperature on laying hens performance was due to the reduced feed consumption. Furthermore, Webster and Czarick (2000) found that, according to the temperature fluctuation inside the closed house, egg size was larger at the centre sites which were the coolest sites. The authors reported that, excessive variation of temperature in different places inside the house will lead to marked variation in feed consumption and hence egg size differs greatly. At location (C) where the temperature range was highest (13-32 °C) number of broken eggs significantly (P≤0.01) increased. This speculated by Sauveur and Picard (1987) who reported that, eggshell quality was affected directly by high temperature and indirectly by reduced feed consumption. Lin et al. (2004) also, agreed with this finding. Authors mentioned that, high temperature resulted in decrease in eggshell thickness and increase in egg breakage.

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