EVALUATING DIFFERENT PATTERNS OF ENVIRONMENTAL ENRICHMENT AND THEIR IMPACT ON SOME EGG QUALITY CHARACTERISTICS

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Abstract

The effect of three types of environmental enrichment, perches, dust baths, and threshing bales, which are the first factor and the second factor, breeding density and the effect of each of them on the production performance of table egg chickens were studied and chickens were raised in eighteen cages, nine of them with (28) birds/cage and the second nine cages with (20) birds/cage. During the measurement of egg qualities, the enrichment factors did not have a significant effect on the average egg weight. Regarding the qualitative characteristics of the eggs, the environmental enrichment using perches showed a significant increase in the relative weight of the shell, other qualitative characteristics were not affected, and the rearing density had no significant effect on the qualitative characteristics of the eggs. The interaction between the studied factors showed a significant effect on egg qualitative traits, the most important of which was the increase in the relative weight of the egg lying (albumin) and the relative weight of the yolk in the environment provided with roosts and for both densities.

Key words: egg quality, laying hens, rearing density, environment type.

.1 Introduction

The poultry industry has developed significantly over the past decades as a result of the continuous and increasing demand for animal protein compared to plant protein [1,2]. Table egg production is of great importance not only in the Iraqi economy but in most economies of the world, as it provides a basic foodstuff for individuals, as the protein content in one egg table egg is 12% and this protein is considered one of the best types of natural proteins [3,4.[

One way to improve welfare is to improve the environment of chickens, which involves making biological modifications to the managed environment for the chickens. These modifications provide functional benefits in the short or long term. These modifications include providing perches, dust baths, hay bales, and various structures that enhance environmental welfare. This gives the chickens more opportunity to engage in their natural species-specific behaviors, as well as providing more space to move and express those behaviors[5].Significant improved has been made over the past 20 years in developing methods to assess chicken health and welfare, which is difficult because there are many factors to consider including diseases, the ability to perform certain behaviors, and the ability to deal with a stressful environment at times [6]. Enrichmentof the Japanese quail (Coturnix japonica) rearing environment was found to have a positive effect on the behavioural welfare indicators of the birds, although the

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physiological responses depended on the type of organism used [7.[

This study aimed to introduce some environmental stimuli, namely the broiler bale, perches, and dust bath as a kind of simulation of the natural environment and its effect on the qualitative characteristics of the eggs.

.2 Materials and Methods

This experiment was conducted in the fields of poultry birds affiliated with the University of Tikrit / Faculty of Agriculture / Department of Animal Production for the period from 12/5/2024 to 4/8/2024, in which (423) ISA Brown laying hens (42) weeks old, where the study aimed to show the effect of three types of environmental stimuli perches, dust pigeons and bale dries, which is the first factor of the study and the second factor of breeding intensity and the effect of both alone or in combination on the productive performance of table egg chickens.

The chickens were reared in eighteen cages, nine of them with 28 birds/cage and the second nine cages with 20 birds/cage, and the dimensions of one cage were (2 x 2 m) made of iron mesh. Water and feed were provided according to the Hy-Line Brow2019 Chicken Breeding Guide. The flock was fed a special feed for table egg production prepared by the Al-Mu'tasim Modern Feed Factory located in the Al-Mu'tasim District. The feed contains (17) crude protein and an energy amount of 2750 kilocalories.

The qualitative characteristics of the eggs were studied, where two eggs were taken from each replicate once every 28 days, the number of eggs for each treatment was twelve eggs, and the total number of eggs was thirty-six eggs, and the eggs were randomly selected from each treatment after placing them in the refrigerator for twenty-four hours at a temperature of 5°C, Eggs were broken on a flat glass surface to measure the following characteristics: average egg weight (g), shell weight (g), shell thickness (mm), yolk weight (g), white weight (g), yolk index (g), yolk index [8], white index [9.[

The data were statistically analyzed using a completely randomized design for a two-factor experiment, which represented 3×2×3. The first factor was the types of environmental enrichment, which were roosts, dust baths, and hay bales. The second factor was the breeding density of laying hens, with three replicates. Then, the data were analyzed using Duncan's [10] multiple-nomial test to test the significance of the differences between the means and the interaction of the studied factors, noting that the statistical analysis was conducted using the ready-made statistical analysis SAS (2004) [11] to analyze the data.

.3 Results and discussion

.3.1 Effect of environmental enrichment on egg weight (g.(

It can be seen from Table (1) that the birds provided with the dust bath environment recorded a significant superiority compared to the birds provided with the roosts and the threshing bale environment. As for breeding density, there was no significant effect for both densities. The birds enriched with dust pigeons at densities of 28 and 20 birds/cage recorded a significant superiority in terms of overlap over roosts and bales according to the statistical analysis.

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Table (1): Effect of environmental enrichment by different methods on egg weight (g) in ISA Brown egg chickens.

Egg Weight (g)					
Overlap		Density effect		Enrichment effect	
abc 0.91± 59.7	R1*D1	60.4±0.89 a	D1 (28 birds /cage)	0.84± 58.17 b	R1
a 1.50± 63.2	R2*D1				
bc 0.22± 58.3	R3*D1			1.02 ±62.82 a	R2
c 0.65± 56.6	R1*D2	60 .24±1.09 a	D2 (20 birds /cage)		
a 1.66± 62.3	R2*D2			0.93 ± 60.0 b	R3
ab 1.22± 61.6	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage.

It can be seen from Table (2) that there was no significant effect on the yolk index according to the environmental enrichment pattern, breeding density, and the interaction between them at a significant level (P≤0.05.(

.3.2 Effect of environmental enrichment on yolk index

Table (2): Effect of different environmental enrichment methods on yolk index in ISA Brown egg chickens reared at different densities.

Yolk Index					
Overlap		Density effect		Enrichment effect	
a 0.050± 0.5	R1*D1	a 0.44±0.01	D1 (28 birds /cage)	a 0.02 ±0.43	R1
a 0.025± 0.43	R2*D1				
a 0.027± 0.45	R3*D1			a 0.01 ±0.43	R2
a 0.014± 0.41	R1*D2	a 0.43±0.01	D2 (20 birds /cage)		
a 0.016± 0.44	R2*D2			a 0.01 ±0.45	R3
a 0.028± 0.44	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage.

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.3.3 Effect of environmental enrichment on relative yolk weight

Birds reared in an environment with a dust bath as a source of environmental enrichment recorded a significant decrease in relative yolk weight compared to birds with roosts. The number of birds raised per unit area did not have a significant effect on this trait. The same was true for all the interactions of the studied factors (Table 3.(

Table (3): Effect of different environmental enrichment methods on relative yolk weight in ISA Brown egg chickens reared at different densities .

Relative weight of yolk/g					
Overlap		Density effect		Enrichment effect	
a 0.3± 11.3	R1*D1	10.9±0.2 a	D1 (28 birds /cage)	a 0.21 ±11.3	R1
a 0.42± 10.5	R2*D1				
a 0.3±10.94	R3*D1			b 0.251 ±10.48	R2
a 0.4± 11.30	R1*D2	10.8±0.2 a	D2 (20 birds /cage)		
a 0.4± 10.51	R2*D2			ab 0.213 ±10.72	R3
a 0.43± 10.50	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage

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.3.4 Effect of environmental enrichment on laying index

From Table (4), there were no significant differences in the effect of environmental enrichment and rearing density on the laying index. As for the interventions, it was found that birds provided with their environment with roosts at a density of 28 birds/cage recorded a significant superiority over the interventions of roosts and dust pigeons at a density of 20 birds/cage according to the results of the statistical analysis.

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Table (4): Effect of environmental enrichment by different methods on laying index in ISA Brown hens reared at two densities.

laying index					
Overlap		Density effect		Enrichment effect	
a 0.005± 0.41	R1*D1	a 0.40±0.004	D1 (28 birds /cage)	a 0.01 ±0.40	R1
abc 0.008± 0.4	R2*D1				
abc 0.006± 0.4	R3*D1			a 0.01 ±0.39	R2
c 0.005± 0.4	R1*D2	a 0.39±0.004	D2 (20 birds /cage)		
bc 0.006± 0.4	R2*D2			a 0.01 ±0.40	R3
ab 0.007± 0.41	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage.

.3.5 Effect of environmental enrichment on relative laying weight

Environmental enrichment patterns and rearing density did not have a significant effect on relative egg weight. To show the effect of the interference between environmental enrichment pattern and rearing density, we note that birds reared at a density of 20 birds/cage and the presence of threshing bales recorded a significant decrease in the relative weight of eggs compared to the interference with the presence of perches under two rearing densities of 20 and 28 birds/cage Table (5 .(

Table (5): Effect of environmental enrichment by different methods on relative laying weight in ISA Brown egg chickens.

Relative laying weight %					
Overlap		Density effect		Enrichment effect	
a 0.15± 26.3	R1*D1	a 26.26±0.33	D1 (28 birds /cage)	a 0.13 ±26.62	R1
ab 1.08± 26.2	R2*D1				
ab 0.35± 26.1	R3*D1			a 0.63 ±25.68	R2
a 0.65± 26.8	R1*D2	a 25.39±0.49	D2 (20 birds /cage)		
ab 0.70± 25.1	R2*D2			a 0.58 ±25.19	R3
b 0.75± 24.1	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage.

.3.6 Effect of environmental enrichment on shell thickness

The pattern of environmental enrichment, rearing density, and overlap did not have a significant effect on the average shell thickness as shown in Table (6

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Table (6): Effect of different environmental enrichment methods on shell thickness in ISA Brown egg chickens.

Shell thickness/mm					
Overlap		Density effect		Enrichment effect	
a 0.017± 0.33	R1*D1	a 0.33±0.02	D1 (28 birds /cage)	a 0.02 ±0.34	R1
a 0.052± 0.4	R2*D1				
a 0.017± 0.3	R3*D1			a 0.03 ±0.36	R2
a 0.052± 0.4	R1*D2	a 0.35±0.02	D2 (20 birds /cage)		
a 0.053± 0.34	R2*D2			a 0.2 ±0.33	R3
a 0.045± 0.36	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage.

.3.7 Effect of environmental enrichment on relative shell weight

To indicate the effect of environmental enrichment patterns on the relative weight of the shell, we note that birds enriched with roosts recorded a significant superiority over birds enriched with dust baths. Regarding the breeding density and its interaction with the environmental enrichment pattern, no significant differences were found in the relative weight of the eggshell as shown in Table (7.(

Table (7): Effect of different environmental enrichment methods on relative shell weight in ISA Brown egg chickens.

relative shell weight%					
Overlap		Density effect		Enrichment effect	
a 0.27± 11.3	R1*D1	a 10 .89±0.20	D1 (28 birds /cage)	a 0.20 ±11.29	R1
a 0.42± 10.4	R2*D1				
a 0.25± 10.9	R3*D1			b 0.25 ±10.47	R2
a 0.36± 11.2	R1*D2	a 10 .76±0.22	D2 (20 birds /cage)		
a 0.36± 10.5	R2*D2			ab 0.21 ±10.72	R3
a 0.34± 10.5	R3*D2				

Significant differences between the coefficients at the (P≤0.05) level. Wherein: R1 perches, R2 dust baths, R3 Bale dries.D1: Density of 28 birds/cage, D2: 20 birds/cage.

In general, most egg quality characteristics were not affected by environmental enrichment patterns or rearing intensity and the interaction between them. However, the

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relative weight of the eggshell showed a significant decrease in the group of birds enriched with dust baths compared to chickens enriched with roosts. This decrease may be due to the increase in egg weight and production rate. The surface area required for shell deposition increases with increasing egg weight [12]. [13] observed a negative significant correlation coefficient between egg weight rate and productivity in light of equal shell thickness rate. The relative increase in the weight of the cortex is due to the activity of some hormones that regulate calcium metabolism in the body, the most important of which is the PTH hormone, which is secreted by the parathyroid gland in response to a decrease in the level of calcium in the blood. This hormone works to release calcium from the bones by stimulating the osteoclasts to dissolve the collagen rods that hold the calcium crystals, and then the calcium dissolves and is released into the bloodstream to be deposited in the cortical gland area (uterus) in the form of calcium carbonate [14], this process is carried out with the help of estrogen and calcitonin [15 .[

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