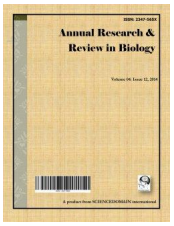

Annual Research & Review in Biology

29(2): 1-5, 2018; Article no.ARRB.41948
ISSN: 2347-565X, NLM ID: 101632869

Effect of Tier Level, Exposure and Period on Egg Production and Grade of Eggs

Adekola Omololu Atanda[1], Okeke Rufina Obioma[1], Balami Samuel Paul[1], Louis Ugwu[2], Abdullahi Idris[3] and Oludayo Michael Akinsola[4*]

[1]Department of Animal Science, Ahmadu Bello University, Nigeria.
[2]Department of Biology, School of Science, Federal College of Education, Katsina, Nigeria.
[3]National Animal Production Research Institute, Ahmadu Bello University, Nigeria.
[4]Department of Theriogenology and Production, University of Jos, Nigeria.

Authors' contributions

The study was carried out in collaboration between all authors. Author AOA designed the study. Author ORO wrote the protocol. Author BSP wrote the first draft of the manuscript. Author LU managed the proofreading of the manuscript. Author AI managed the literature searches. Author OMA managed the analyses and the data collection. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARRB/2018/41948
Editor(s):
(1) Dr. Rajeev Kumar, Department of Veterinary Public Health & Epidemiology, Vanbandhu College of Veterinary Science & A.H, Navsari Agricultural University, Navsari, India.
(2) Dr. George Perry, Dean and Professor of Biology, University of Texas at San Antonio, USA.
Reviewers:
(1) Joke Adesola, Dalhousie University, Canada.
(2) Tamer Çağlayan, Selcuk University, Turkey.
Complete Peer review History: http://www.sciencedomain.org/review-history/26794

Short Research Article

Received 07 May 2018
Accepted 21 September 2018
Published 23 October 2018

ABSTRACT

A total of 230 Nera birds were studied in an open and close-ended layer house for 6 weeks to determine the effect of cage location, tier level, and exposure of bird on egg production. Birds were supplied *ad Libitum* with feed and water. Eggs were collected twice daily at 11.00 am, and 4.00 p.m. counted, weighed and classified into sizes. The production of the egg was found to be significantly influenced by the location of laying hen. The upper tier recorded 29.17% superiority over the lower tier. This showed that birds laid more eggs in the upper tier. Besides, tier did not significantly ($P < 0.05$) affect the sizes of the egg laid. In this study, the birds used were exposed to light and dark conditions. The result obtained showed that more eggs were produced at the better lit area than the more shaded area. It is therefore economically viable to have more light in the

**Corresponding author: E-mail: dayoakinsola@gmail.com;*

laying house for increased egg production. Furthermore, it was observed from the result of the experiment that more medium-sized eggs were produced in the better lit area than the darker parts of the house.

Keywords: Nera birds; egg grade; tier level; cage location; laying performance.

1. INTRODUCTION

The well being of chicks has been shown to play a significant role in their pullet and laying performances [1]. What determines an animal's welfare is unique to its genotype and the environment in which it is raised, and can be assessed by monitoring the mental and physical state of the animal [2,3,4]. According to McNitt [5]; Mohanlal [6], the cage is more modern, beneficial and economical than the deep litter floor. Caged birds gave higher egg production than birds on litters. Other advantages of cage poultry system include economy of space, moisture avoidance that prevent disease outbreak and integration with other methods such as fish and swamp rice farming. It also enables effective record keeping, identification of poor producers and prompt culling, control of social vices such as cannibalism and egg eating. Cage system allows the production of clean eggs, removal of stress factors and it assists in the control of feed wastage. Today, multiple-hen cages have essentially replaced floor pens. North [7] estimated that 75% of all the commercial layers in the world are now kept in cages. It is a common rearing practice to house layer chicks in multiple-deck cage systems at high densities to meet the demand for pullets [8]. Despite welfare concerns, cage systems remain sustainable due to the efficient use of land and labour. Cages are usually constructed in different tiers. Because there is an unavoidable variation in light intensity among tiers in multitier cage systems, a balance is needed between providing sufficient light at the bottom tier and avoiding excessive light intensity at the top tier [2].

Natural daylight is the primary factor for developing a lighting program for laying hens in semi-confinement houses [4]. Thus, artificial light is provided to compensate for shortened daylight hours [9,4]. The intensity of light is also one of the most important aspects of egg production [3]. A threshold light intensity is crucial for stimulating hypothalamic receptors responsible for photo sexual variables. When the recommended light intensity is not met, it can lead to compromised egg production and egg weight due to variability in the rate of lay. Provision of homogeneous illumination to each tier is an inevitable challenge in semi-confined laying hen houses.

It was hypothesised that the lack of homogeneous light intensity in multitier systems and each cage location in semi-confined laying hen houses adversely affects egg production and quality [4]. By mimicking entirely confined housing system regarding providing uniform light intensity, this experiment was conducted to determine the effects of cage location and tier level on egg production and egg quality parameters of hens raised in a semi-confined facility with multitier cage system.

It is observed that a flock of layers usually does not produce the same number of eggs every day. Sometimes, the figures vary reasonably but occasionally; the variations can be very sharp, appearing suspicious. The objective of this study is to compare the performance of the layer chicken in the different tiers of the 2-tier cage over a period of 6 weeks to reassess the hypothesis that the tier the uppermost tier of the multitier cages is relatively the most efficient regarding egg production compared to the lower tiers.

2. MATERIALS AND METHODS

The study was carried out on the Teaching and Research farm of the Federal University of Technology Akure, Ondo State of Nigeria. The experiment was carried out during of November and December. In this study, a total of two hundred and forty commercial Nera breed chicken were used for six weeks duration, when they were 36 – 41 weeks old. The hens for this experiment were offered feed and water *ad libitum*, with a commercial layer mash containing 2750 Kcal/kg metabolisable energy and 16.1% crude protein. The birds were raised in closed-ends (wall facing) and open sides (covered with wire gauze) poultry house, with a gable.

The birds were allocated randomly three per cell, to 2-tier battery cages and the set-up replicated three times. There was a walk through corridor in-between the battery cage columns. As a result

of the arrangement, two groups of birds faced each other. Furthermore, the doors at the two ends of the poultry house were mostly closed during day hours (7.30 a.m – 7.00 p.m) which give dark effect at the middle of the house and only opened when there was need such as feeding, watering, collection of eggs and removal of faeces. Due to the arrangement of birds in the battery cages, the 2-tiers were considered as two different heights (upper and lower). There were also two areas of bird exposure, the side of the enclosure facing the light (light area) and the side of the cage within the middle, in-between two rows of cages (dark area).

Eggs were collected at 11.00 a.m. and 4.00p.m. daily and graded immediately after the last day's collection. Eggs were weighed on electronic meter 3000 g balance using improvised 4-cell egg tray for holding egg during weighing. The percentage superiority of the upper over lower tier in term of production was calculated weekly.

$$\% \text{ superiority} = \frac{\text{Upper} - \text{Lower}}{\text{Lower}} \times 100$$

The data obtained from egg production parameter were analysed using analysis of variance technique for Randomized Complete Block Factorial Design as described by Snedecon and Cohran [10] and tested at 5% and 1% level of significance. Significant differences were also determined upper and lower tiers and between light and dark areas by using paired t-test as described by Akindele [11]. The 2-way ANOVA was employed using the GLM procedure [12]. The linear model to test the effects of the factorial arrangements of treatments (2 locations and 2 tiers) on egg production and egg quality parameters included the primary impact of cage location and tier level and cage location by tier level interaction. Statistical significance ($P < 0.05$) was attained using the LSD option.

3. RESULTS AND DISCUSSION

The effect of period on egg production revealed that birds laid more eggs in the morning than in the evening and the differences were highly significant ($P < 0.05$) as shown in Table 1 below. This could be attributed to the fact that laying pattern within a cycle is a characteristic of the first egg laid in the morning (about 7.00 am to 8.00 am which is dependent on lighting conditions). Abdelkarim and Biellier [13] noted a significant improvement in egg production as the light intensity was increased progressively during the day hours. Cavalchini et al. [14] also reported a linear increase in egg production as light intensity increased during the day and supported by artificial lighting. Renema et al. [15] tested the effects of various light intensity on laying performance. As light intensity increased, egg production increased quadratically.

There were averagely more eggs from birds housed in the upper tier (876.75 ± 28.00) than those in the lower tier (678.75 ± 51.38) as shown in Table 1. There were significant differences ($P > 0.05$) in the number of eggs between the upper and lower tiers. The average superiority of the upper over the lower tier was 29.17%. However, Vovency [16] reported a non-significant variability among the groups caged at different tier levels facing windows and located in corridors. The effect of tier level and location on egg production in the study reported by Abdelkarim and Biellier, [13] is consistent with the findings of this experiment. Yildiz et al. [4] also reported greater egg production by hens in the upper tier than hens in the bottom tier and facing the corridor.

There was no significant ($P > 0.05$) effect of exposure (light or dark) on egg production (Table 3). However, more eggs were laid under the light than the dark condition. The average superiority of light over the dark condition in total egg production was 3.78%. The greater number of eggs obtained from the birds exposed to light is in agreement with the report of other researchers.

The effect of exposure, however, was noticed within the grade of eggs. Among all the grades, more highly significant ($P < 0.01$) number of eggs was recorded for a medium-sized grade under light condition than under dark (Table 4).

The heavier eggs laid by birds due to light in this experiment agrees with the report of Makinde [17]. Cage location, but not tier level was reported to affect egg weight [4]. He reported that hens facing the window produced heavier eggs than those facing the corridor. Hens at the top tier and facing the window produced an average of 2.8 g heavier eggs than hens at the bottom tier

Table 1. Effect of tier levels on the egg production

Age (week)	Upper tier	Lower tier	SEM	Level of significance
36	132.75[a]	107.50[b]	9.24	* *
37	146.50[a]	117.50[b]	4.32	* *
38	139.50[a]	114.75[b]	5.58	* *
39	145.00[a]	110.50[b]	7.62	* *
40	157.75[a]	117.00[b]	10.34	* *
41	155.25[a]	111.50[b]	11.44	* *
Total	876.75[a]	678.75[b]	72.22	* *
Average	146.13[a]	113.25[b]	4.75	* *

*a,b = values within same row with different superscripts are significantly different (P < 0.05), **: highly significantly (P < 0.01)*

Table 2. Effect of tier levels on the grade of eggs

Egg size	Upper tier	Lower tier	SEM	level of significance
Jumbo	13.00	12.50	2.70	NS
Extra-large	132.17	108.33	16.16	NS
Large	320.33	323.83	22.32	NS
Medium	135.33	144.00	12.32	NS
Small	5.67	6.33	3.77	NS
Peewee	0.67	0.50	0.54	NS

Table 3. Effect of exposure on egg production

Age (week)	Light	Dark	Total	% light superiority
36	555	526	1081	5.51
37	563	573	1136	-1.75
38	612	605	1217	1.16
39	649	613	1262	5.87
40	651	608	1259	7.07
41	648	619	1267	4.68
	3678	3544	7227	3.78

Table 4. Effect on exposure (Light vs Dark) on the grade of eggs

Egg size	Light	Dark	SEM
Jumbo	10.50	15.00	2.63
Extra large	107.67	132.83	15.47
Large	322.83	321.33	22.12
Medium	162.50[a]	117.83[b]	13.21
Small	8.50	3.50	3.71
Peewee	1.00	0.50	0.65

a, b = means value on the same row with different superscripts are significantly different (P < 0.05)

and facing the corridor, suggesting that light intensity level and exposure increased egg weight [4]. Leeson and Lewis [18], however, reported no difference in egg weight of hens exposed to light intensity varying as a result of exposure due to location. Renema et al. [15] reported linear decreases in egg weight (from 74.4 to 58.5 g) and greater percentage of smaller eggs (<56 g, 40.2 to 25.1%) as light intensity and exposure decreased. Using raw data from several experiments published, Lewis and Morris [19] fitted the relationship between egg weight and light intensity to a linear regression line and because egg weight is negatively correlated with egg production, it seems that effect of light intensity on egg weight is through its effect on egg production and possibly feed intake, which was not measured in the present experiment.

4. CONCLUSION

Cages exposed to natural daylight through windows had the most significant light intensity, followed by those artificially illuminated, or by corridor side. Variation in light intensity was the greatest for cages exposed to natural daylight and the lowest for artificially illuminated cages.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bozkurt Z, Bayram İ, Türkmenoğlu İ, Aktepe OC. Effects of cage density and cage position on performance of commercial layer pullets from four genotypes. Turkish Journal of Veterinary and Animal Sciences. 2006;30(1):17-28.
2. Awoniyi TAM. The effect of housing on layer chicken's productivity in the 3-tier cage. Int. J. Poult. Sci. 2003;2:438–441.
3. Morris TR. Environmental control for layers. World's Poult. Sci. J. 2004;60:163–175.
4. Yildiz A, Lacin E, Hayirli A, Macit M. Effects of cage location and tier level with respect to light intensity in semi confined housing on egg production and quality during the late laying period. J. Applied Poult. Res. 2006;15:355-361.
5. McNitt JI. Livestock husbandry techniques. Gramada Publishing Limited Great Britain Copyright. 1983;215-222.
6. Mohanlal GM. Livestock and poultry enterprises for rural development. 1985; 920-923.
7. North MO. Commercial chicken production manual. 3rd Edition. Avi Publishing Company Inc. West Port C.T.; 1984.
8. National Research Council. Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC; 1994.
9. Lewis PD, Perry GC, Morris TR, English J. Supplementary dim light differentially influences sexual maturity, oviposition time, and melatonin rhythms in pullets. Poult. Sci. 2001;80:1723–1728.
10. Snedecor CW, Cochran WG. Statistical methods. 6th Edition. Iowa State Univ. Press, Iowa; 1980.
11. Akindele SO. Lecture on notes on biometrics in agriculture (Design and Analysis of Agricultural Experiments). 1989;1-2.
12. SAS Institute. SAS User's Guide: Statistics. Version 7. SAS Inst. Inc., Cary, NC; 1998.
13. Abdelkarim MR, Biellier HV. Effect of light intensity and photoperiod on chicken laying hens. Poult. Sci. 1982;61:1403–1404.
14. Cavalchini LG, Pignatelli P, Sartore G. L'influenza della luca galline ovaiole. Rivista de Zootechnia e Veterinaria. 1976;2:159–162.
15. Renema RA, Robinson FE, Feddes JJ, Fasenko GM, Zuidhof MJ. Effects of light intensity from photostimulation in four strains of commercial egg layers: 2. Egg production parameters. Poult. Sci. 2001; 80:1121–1131.
16. Vovensy V. The effect of light intensity on egg yield in hens. Zivocisna Vyroba. 1990;35:643–650.
17. Makinde K. Effect of Environmental temperature, Relative humidity and location of laying house on layer performance. M. Sci. Thesis, Obafemi Awolowo Univ. Ile-Ife; 1986.
18. Leeson S, Lewis PD. Changes in light intensity during the rearing period can influence egg production in domestic fowl. Br. Poult. Sci. 2004;45:316–319.
19. Lewis PD, Morris TR. Light intensity and performance of domestic pullets. World's Poult. Sci. J. 1999;55:241–250.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/26794