

PERFORMANCE OF HENS EXPOSED TO VARYING LIGHTING COLOURS AND INTENSITIES AT THE EARLY LAYING PHASE

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ABSTRACT

The implications of lighting colour and intensity on performance of laying hens at the early laying phase were assessed in this study. Isa Brown pullets (n=390), aged 18-week, were randomly allotted to four lighting colour (Blue, Green, Red, and White) and three lighting intensities (9, 13.5, and 18 lux) in a (4×3) +1 augmented factorial experiment (daily exposure to extra four hours of artificial lighting and the natural day length) of a completely randomised design. Each treatment was replicated five times, and a replicate comprised six hens. Eggs production was recorded daily, while the body weights record was weekly. Data were analysed using descriptive statistics and ANOVA, and means were separated at $\alpha_{0.05}$. Hens exposed to green and blue colours had similar feed conversion ratio (FCR) of 2.97 and 3.00, respectively which were significantly lower ($p<0.05$) than 3.02 for Red, 3.21 for white, and 3.82 (control). Also, control hens had significantly higher ($p<0.05$) FCR than in other treatments for lighting intensity. Effects of interactions of lighting colour and intensity on FCR differed significantly ($p<0.05$). Lowest FCR ($p<0.05$) was in hens on blue colour × 9.0 lux. Control × 0 hens had least hen-day egg production (HDEP) ($p<0.05$) of 61.43%, than in other treatments. Therefore, varying lighting colour and intensity for the laying hens could be a vital tool for the enhancement of economic returns and increased productivity as obtained in hens on green and blue colours in this study.

Keywords: Laying hens, Egg mass, Feed conversion ratio, Hen-day egg production, ISA Brown.

INTRODUCTION

Lighting is an important environmental factor that affects the behaviour, egg production and quality, and health of laying hens (Svobodova *et al.*, 2015). Artificial illumination is widely used to improve reproductive performance of laying hens in modern poultry pens (Er *et al.*, 2007). The physiological action of light occurs when perceived by the eye and converted to nerve impulses, which are sent to the brain. Light stimulates the gonadal cycle, causing the onset of lay by animating the nerve centre zone through the eyes or pineal organ to trigger the release of gonadotropin-releasing hormone. This stimulates the anterior pituitary gland to release follicle-stimulating hormone and luteinizing hormone (Chen *et al.*, 2007). Light stimulates the release of sexual hormones, which are responsible for production of important sex steroid hormones like testosterone, oestrogen, and progesterone (Ahmad *et al.*, 2023). Studies on effects of light sources on performance, behaviour, and functional parts of poultry birds have been documented (Khaliq *et al.*, 2018, Al-hsenawi *et al.*, 2020, Zaguri *et al.*, 2020). Proper lighting conditions are crucial for the development and normal function of the reproductive system and overall growth of chickens (Patel *et al.*, 2016). Thus, the propriety of artificial illumination with varying durations, colours, and intensities now devised for use in poultry for improved performance and productivity of laying chickens (Rozenboim *et al.*, 1998).

However, there is paucity of information on effect of lighting colour and its combination with lighting intensity for the laying hens in Nigerian poultry industry. This study aimed at assessing the effects of varying lighting colours and intensities on performance of laying hens at the early laying phase.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Poultry Unit, Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria, which lies between longitude 7°27.05N and 3°53.74 of the Greenwich Meridian East, at an altitude 200m above sea level. The average temperature and relative humidity of the location are between 23-42°C and 60-80%, respectively.

Experimental Design and Animal Management

Isa Brown pullets (n=390), with proven records of medication and vaccination schedule, from 14 weeks old were used for this experiment. The pullets were raised in a conventional cage house, with each cell in the three-tier cage measuring 40 × 41 × 32 cm. The pullets were allotted to varying lighting colours (blue, green, red, and white) and intensities (9, 13.5, and 18 lux), for an additional four hours duration daily (6.30-10:30 pm daily), while those on control group were exposed to the normal photoperiod. The design of the experiment was a (4×3) +1 factorial

experiment of a completely randomized design. Each treatment was replicated five times. The experimental hens were offered isonitrogenous (16.00% crude protein) and isocaloric (2600kcal/kg Metabolisable energy) diets in duration of the study.

Data Collection

Pullets were weighed just after their arrival. Weekly body weight was recorded and the average weight per bird (each replicate was weighed as a whole, then the average weight was calculated) was calculated weekly. Feed intake (g) and feed conversion ratio (FCR) were calculated weekly as indicated by the formulae below:

$$\text{Feed intake/bird} = \frac{\text{Feed offered} - \text{Leftover}}{\text{Birds per replicate}}$$

$$\text{Feed Conversion Ratio} = \frac{\text{Feed Intake}}{\text{Egg mass}}$$

Statistical Analysis

Data were subjected to descriptive statistics and analysis of variance using SAS (2009). Means were separated with the Duncan's Multiple Range Test option of the same software at $\alpha_{0.05}$.

RESULTS AND DISCUSSION

The main effect of lighting colour on performance of hens at the early laying phase is presented in Table 1. The feed intake of the chickens was not influenced ($p>0.05$) by lighting colour, suggesting no notable influence of colour on appetite of the hens. This observation conforms with those of Ahmad *et al.* (2011), that lighting colour did not influence the feed intake of broiler chicken. Lighting colour increased the egg mass (g) ($p<0.05$) across treatments (41.03, 41.62, and 42.83, respectively), when compared to the control (34.40). This implies that lighting colour can positively influence protein deposition into eggs. The FCR of hens exposed to the varying colours differed significantly ($p<0.05$) to the control (3.82), suggesting that lighting colour may could improve efficiency of nutrient utilisation in the hens. This observation underscores the assertion of Hassan *et al.* (2013), on the efficiency of lighting colour for FCR enhancement. Hens exposed to all tested lighting colours had significantly higher HDEP (%) ($p<0.05$) (74.21, 75.90, 76.57, and 77.01, respectively), when compared to the control (61.43), showing a positive influence of lighting colour on ovulation or egg formation processes, culminating to increased egg production. Lewis and Morris (2000) earlier posited that specific lighting colours enhanced layers egg production.

Table 1: Main Effect of Lighting Colour on Performance of Hens at the Early Laying Phase

	Control	Blue	Green	Red	White	SEM
Feed Intake (g)	118.66±1.93	117.74±2.42	119.55±1.50	117.27±3.66	118.15±2.05	0.78
Egg Mass (g)	34.40±3.11 ^b	41.62±4.40 ^{ab}	42.83±3.81 ^a	41.03±4.37 ^{ab}	40.27±5.64 ^{ab}	1.55
FCR	3.82±0.33 ^a	3.00±0.30 ^b	2.97±0.26 ^b	3.02±0.36 ^b	3.21±0.59 ^{ab}	0.14
HDEP (%)	61.43±0.61 ^b	74.21±6.76 ^a	77.01±4.32 ^a	76.57±8.82 ^a	75.90±7.82 ^a	2.34

^{abc}Means across the same row with different superscripts are significantly different (<0.05), FCR= Feed conversion ratio, HDEP= Hen-day egg production.

The main effect of lighting intensity on performance of laying chickens at the early laying phase is shown in Table 2. Lighting intensity did not affect ($p>0.05$) the feed intake (g) across all the treatments, when compared to the control (118.66), suggesting a minimal influence of lighting intensity on feed intake in layers. Ahmad *et al.* (2011) showed that the lighting intensity did not influence feed intake of broiler chickens. Lighting intensity improved ($p<0.05$) the egg mass (g) across treatments when compared to the control (34.40), suggesting that lighting intensity could be used to stimulate protein accretion and mobilization in the hen for increased egg production.

Table 2: Main Effect of Lighting Intensity on Performance of Hens at the Early Laying Phase

	Control	9lx	13.5lx	18lx	SEM
Feed Intake (g)	118.66±1.93	118.79±1.91	117.38±3.30	118.37±2.31	0.95
Egg Mass (g)	34.40±3.11 ^b	42.55±4.79 ^a	42.01±4.49 ^a	39.76±4.08 ^{ab}	1.90
FCR	3.82±0.33 ^a	2.95±0.34 ^b	3.01±0.33 ^b	3.20±0.48 ^b	0.17
HDEP (%)	61.43±0.61 ^b	79.10±6.54 ^a	74.37±6.73 ^a	74.28±6.85 ^a	2.87

^{abc}Means across the same row with different superscripts are significantly different (<0.05), FCR= Feed conversion ratio, HDEP= Hen-day egg production.

Lighting intensity significantly lowered ($p<0.05$) the FCR (3.20, 3.01, and 2.95, respectively) across treatments when compared to the control (3.82). This implies that lighting regimen improved the efficiency of feed utilisation

for egg production as earlier opined similarly (Hassan *et al.*, 2013). All tested lighting intensities had significantly higher ($p<0.05$) HDEP (%) (74.28, 74.37, 79.10) than hens on control treatment. This implies that lighting intensity could positively improve protein mobilization and deposition, leading to increased egg production.

Effect of interaction of lighting colour and intensity on performance of hens at the early laying phase is presented in Table 3. Feed intake of the laying hens was not influenced ($p>0.05$) by the lighting combinations. Thus, indicating that varying lighting conditions had no effect ingestion of chickens at the early laying phase. Wichman *et al.* (2021) similarly posited that different lighting spectrums did not affect feed intake in laying chickens. When compared to the control with 34.40 ± 3.11 egg mass (g), the tested lighting conditions had no effect on egg mass (g) across treatments. Huber-Eicher *et al.* (2013) similarly showed that lighting conditions did not affect the egg mass of chickens.

Table 3: Effect of Interaction of Lighting Colour and Intensity on Performance of Hens at the Early Laying Phase

Colour	Intensity (lx)	Feed intake (g)	Egg mass (g)	FCR	HDEP (%)
Control	0	118.66 ± 1.93^{ab}	34.40 ± 3.11	3.82 ± 0.33^a	61.43 ± 0.61^b
Blue	9	118.80 ± 2.12^{ab}	44.94 ± 3.38	2.75 ± 0.12^b	78.24 ± 9.43^a
	13.5	115.85 ± 3.19^{ab}	40.52 ± 6.06	3.03 ± 0.39^{ab}	70.05 ± 5.49^{ab}
	18	118.58 ± 0.77^{ab}	39.41 ± 1.93	3.20 ± 0.20^{ab}	74.35 ± 3.65^{ab}
Green	9	120.72 ± 0.35^a	44.29 ± 6.50	2.90 ± 0.43^{ab}	79.28 ± 5.80^a
	13.5	119.30 ± 1.49^{ab}	42.95 ± 2.22	3.02 ± 0.23^{ab}	75.36 ± 3.89^{ab}
	18	118.61 ± 1.78^{ab}	41.26 ± 1.98	3.00 ± 0.13^{ab}	76.40 ± 3.67^{ab}
Red	9	118.67 ± 2.01^{ab}	42.47 ± 2.27	2.91 ± 0.16^{ab}	78.95 ± 7.96^a
	13.5	114.53 ± 3.98^b	40.73 ± 6.02	2.97 ± 0.40^{ab}	74.06 ± 10.96^{ab}
	18	118.62 ± 4.11^{ab}	39.88 ± 5.45	3.19 ± 0.53^{ab}	76.69 ± 10.48^{ab}
White	9	116.98 ± 0.90^{ab}	38.49 ± 5.43	3.24 ± 0.45^{ab}	79.95 ± 6.84^a
	13.5	119.82 ± 1.26^{ab}	43.81 ± 4.60	3.00 ± 0.47^{ab}	78.03 ± 5.85^a
	18	117.66 ± 2.77^{ab}	38.52 ± 6.95	3.39 ± 0.91^{ab}	69.68 ± 8.60^{ab}
SEM		1.35	2.69	0.24	4.06

^{abc}Means of treatments along the same column with different superscripts are significantly different ($p<0.05$), FCR= Feed Conversion Ratio, HDEP= Hen-Day Egg production

The varying lighting intensities lowered the FCR across treatments ($p<0.05$), when compared to the control (3.82 ± 0.33). This implies that lighting conditions increased the efficiency of feed conversion in chickens at the early laying phase, which conversely contradicts assertion of Borille *et al.* (2013) that varying LED light sources would not affect the FCR of laying hens. Lighting colour x intensity significantly increased ($p<0.05$) the hens HDEP (%) across treatments when compared to those on control (61.43), validating the much earlier assertions of Hassan *et al.* (2014) that lighting regimen was capable of modulating hormonal cascades for resultant enhancement of laying hens egg production.

CONCLUSION

It was concluded that varying regimen of lighting colour and intensity could be a veritable tool for increased productivity through enhancement of biological and eventual economic returns of laying hens as shown by the laying hens exposed to green and blue colours in this study.

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