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# The effect of bodyweight variation on laying performances of Shaver brown hen in humid tropical environment

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***Target audience**: Farmers and researchers.*

## Abstract

*The study was conducted to investigate the effect of variation in body weight on laying performance of Shaver Brown hen in humid tropical environment. A total of 96 Shaver brown hens at their sixth week of lay were used. The hens were separated on the basis of their bodyweight, divided into four groups of 24 birds per group 0.9-1.2kg for the first group, 1.3-1.4kg for the second group, 1.5-1.6kg for the third group, 1.7-2.0kg for the fourth group. Each group was replicated 4times with 6birds per replicate. The study lasted for ten weeks. Data generated were subjected to the analysis of variance (ANOVA) using SPSS version 20 of 2011 while statistically different means were separated using Duncan's option found in statistical package/software. In the experiment, there were significant differences in total egg production, Hen day egg production, Hen housed egg production, average daily feed intake, egg weight, egg shell thickness, albumin height, albumin diameter, yolk height, % egg production, yolk weight, albumin weight, dozens of eggs produced per bird, revenue from dozens of eggs produced and in gross profit. The study had shown that the heavy body weight hens were significantly (P< 0.05) higher to the light body weight hens in terms of egg quality but not on total egg production. Therefore, rearing of pullets according to bodyweight groups is advantageous and could be practiced by poultry farmers in order to obtain improved performance of the flock and offer potential economic savings through more efficient production.*

***Key words**: Bodyweight, laying performance, egg characteristics and brown chicken.*

## Description of Problem

The need to produce more animal protein in the country has become increasingly urgent in view of the ever rising population. The human population in Nigeria is projected to grow at an annual rate of 2-5% to the year 2025(1). Population growth has surpassed food production and at the moment it is estimated that about one quarter of the population are already facing chronic food insecurity. Poultry is probably the fastest route to achieve any appreciable improvement in the nutritional standard of the populace because of its short generation interval, quick turnover rate and relatively low capital investment (2; 3). Adequate information on growth potentials of existing commercial layers in the country is essential to poultry farmers so as to guide or assist in the choice of stock. Advances in genetic selection make today's commercial layers quite different from those of years ago. Body weight at point of lay is lower, age at first laying is earlier, total egg number has increased, egg mass is greater and feed conversion ratio has improved considerably (4; 5). The existence of variation in bodyweight of birds within the same breed from hatching to sexual maturity is known to exist (6). This variation can be attributed to genetic and environmental factors that affect individual performance. The purpose of production is to obtain the highest level of desired yield at the lowest cost possible. Evaluating the effect of bodyweight on laying performance of birds will help to spur the farmer to achieve uniformity during the growing period of birds through proper flock management. This study therefore was aimed to evaluating the effect of variation of body weight on laying performance of Shaver Brown hen in humid tropical environment of Nigeria

**Materials and Methods**

**Location of the Study:** The study was carried out at the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka .

**Experimental Procedures and Management of Animals:** A total of 96 Shaver brown hens at their sixth week of lay were used. The hens were separated on the basis of their bodyweight, divided into four groups of 24 birds per group: T1= 0.9-1.2kg, T2= 1.3-1.4kg, T3=, 1.5-1.6kg and T4= 1.7-2.0kg (7). Each group was replicated 4times with 6birds per replicate and each replicate was housed in 2.6m x 3m deep litter pen. The hens were fed commercial layers mash containing 16.5%crude protein, 2650kcal/kg of metabolizable energy, 4%crude fat, 6.5%crude fibre, 3.6% calcium and 0.4% phosphorous in a completely randomized design (CRD). Each hen received about 125g of layers mash daily and water was supplied *ad libitum*. Eggs were collected daily and recorded for each group. The number of eggs collected per treatments is as follows: T1 = 51 eggs, T2 = 52 eggs, T3 = 49 eggs and T4= 48 eggs. The study lasted for a period of 10 weeks. As a general flock prophylactic management strategy, routine vaccinations and other health operations were carried out as at when due.

**Parameters Measured**

The following parameters were determined and measured:

**Initial Body Weight (kg)** = the determined weight at the beginning of the experiment was obtained with an electronic kitchen scale (model: EK5350) at 1g sensitivity.

**Final Body Weight (kg)** = the determined weight at the end of the experiment was obtained with an electronic kitchen scale (model: EK5350) at 1g sensitivity.

**Change in average Body Weight (kg)** = Final body weight – Initial body weight.

**Total egg production**

The total egg production was determined by adding all the number of eggs produced in each group during the study.

**Hen day egg production (HDEP) %:**

It was obtained by dividing the total number of eggs collected in each group number of hens alive in each group.

**Hen day egg Production (%)** =

$$\frac{Average\ No\ of\ eggs\ per\ day}{No\ of\ birds\ alive} \times 100\%$$

**Hen housed egg production (HHEP):**

It was obtained by dividing the total number of eggs by each group of hen by the number of hens housed in each group, with mortality not taken into account.

$$HHEP = \frac{No\ of\ eggs\ laid}{No\ of\ hen\ housed} \times 100\%$$

**Average Daily Feed Intake (g)** =

$$\frac{Feed\ offered\ (g) - feed\ leftover\ (g)}{No\ of\ hens}$$

**External parameters measured were**

**Egg weight:** Each egg was weighed within each group using an electronic kitchen scale (model: EK5350) at 1g sensitivity

**Egg quality:** Six eggs per group were selected at random every two weeks to determine the egg quality which is as follows:

**Egg shell weight (g):** The eggs were carefully broken, dried and weighed singly using a weighing balance.

**Egg shell thickness (mm):** The egg shell was pulled off immediately the egg was broken; air dried for a day (24hours) and determined using the micrometer screw gauge.

**Egg shape index:** Egg length and diameter were measured using a vernier caliper and weighed with a digital weighing balance. Egg index was calculated as a ratio of the length to the diameter.

**Table 1: Proximate composition of commercial diet used**

| COMPONENT | % |
|---|---|
| Dry matter | 11.58 |
| Crude protein | 17.01 |
| Ether extract | 3.4 |
| Crude fibre | 5.67 |
| Ash | 2.55 |
| Nitrogen free extract | 59.79 |

**Table 2: Effect of body weight on the performance of Shaver brown hens**

| Parameters | T1 | T2 | T3 | T4 | Sig |
|---|---|---|---|---|---|
| Body Weight(kg) | 1.05 | 1.35 | 1.55 | 1.85 | NS |
| Total egg production | $51.75\pm0.75^{a}$ | $52.0\pm0.57^{a}$ | $49.25\pm0.25^{b}$ | $48.75\pm0.48^{b}$ | * |
| Hen Day Production, % | $73.97\pm1.07^{a}$ | $74.30\pm0.81^{a}$ | $70.35\pm0.35^{b}$ | $69.65\pm0.67^{b}$ | * |
| Hen Housed Egg Production, % | $76.35\pm3.21^{a}$ | $73.69\pm0.86^{ab}$ | $69.87\pm0.31^{b}$ | $69.28\pm0.64^{b}$ | * |
| Average Daily Feed Intake, g | $73.50\pm0.29^{ab}$ | $75.5\pm0.65^{ab}$ | $69.25\pm4.19^{b}$ | $78.50\pm1.32^{a}$ | * |

a,b,c; Mean values in a row with different letter superscripts are significantly ($p<0.05$) different. *= ($P<0.05$); NS= Not Significant.

**Internal parameters measured were**

**Albumin height and diameter (mm/cm)**

The eggs after weighing were broken into piece in a flat glass positioned on a flat surface. Albumin height was taken using a tripod micrometer. Albumin diameter was taken as the maximum cross sectional diameter of the albumin using a pair of callipers and read on a ruler calibrated in millimetre.

**Yolk height and diameter (mm/cm)**

The eggs after weighing were broken into piece on a flat glass positioned on a flat surface. The yolk height was measured using a tripod micrometer. Yolk diameter was taken as the maximum cross sectional diameter of the yolk using a pair of callipers and read on a ruler calibrated in millimetre.

**Albumin index**

The albumin index was calculated as the proportion of yolk height to diameter.

**Yolk index**

The yolk index was calculated as the proportion of yolk height to diameter.

**Haugh unit**

The haugh unit was calculated from the values obtained from the albumin height and egg weight by using the formula:
Haugh's unit=100log $(H+7.57-1.7W^{0.37})$ (8)

**Albumin weight**

The albumin weight was determined after the yolk has been separated from it and placed in a pet dish and weighed in a sensitive scale.

**Yolk weight**

The yolk weight was determined after the albumin has been separated from it and placed in a pet dish and weighed in a sensitive scale

**Percentage egg production**

Percentage egg production for each group of hens was calculated using the formula

$$\%\text{ egg production} = \frac{\text{No of eggs laid by each group for 10weeks}}{\text{No of hens each housed x No of days}} \times \frac{100}{1}$$

**Cost Implication Indices;**

Data generated were used to determine the cost implication of feeding commercial layers' diets to the experimental hens. The economic indices determined include the following:

**Dozens of Egg Produced per bird (dozen)** =
$$\frac{Total\ egg\ number\ per\ bird}{12}$$

**Price per Crate of Egg (₦)** = 1 crate of egg was sold at ₦650 as at the time of the research work.

**Cost of kg of Feed (₦)** =
$$\frac{Amount\ per\ bag\ of\ feed\ (N)}{25kg\ feed\ (1\ bag\ of\ feed)}$$

**Total Feed Consumed (kg)** =
$$\frac{Total\ feed\ consumed\ (g)}{1000}$$

**Cost of Feed Consumed (₦)** = Total feed Consumed (kg) × Cost of kg of feed (₦)

**Price of a Dozen of Egg (₦)** = 1 dozen of egg was sold at ₦260.40 as at the time of the research work.

**Revenue from Dozens of Egg Produced (₦)** = Total dozens of egg produced x Price of one dozen of egg.

**Gross Profit (₦)** = Revenue from dozens of egg produced (₦) - Cost of feed Consumed (₦) (all other things been equal).

**Experimental design and data analysis:** The study was conducted using a completely randomized design (CRD). Data generated were subjected to the analysis of variance (ANOVA) using SPSS version 20 of 2011 while statistically different means were separated using Duncan's option found in statistical package/software(9). The statistical model for the analysis is as follows:

$$Xij = \mu + Ti + \Sigma ij$$

Where:
*Xij*= Individual observation
*U*= Population mean
*Ti*= Treatment mean
*Eij*= Experimental error associated with the observation.

**Table 3: Effect of body weight on the external egg trait of shaver brown hens**

| Parameters | T1 | T2 | T3 | T4 | Sig |
|---|---|---|---|---|---|
| Egg Weight(g) | $61.89\pm0.62^{b}$ | $63.22\pm0.64^{ab}$ | $64.62\pm1.81^{a}$ | $64.65\pm1.06^{a}$ | * |
| Egg Shell Weight(g) | 5.25±0.10 | 5.34±0.13 | 5.39±0.02 | 6.29±0.13 | NS |
| Egg Shell Thickness (mm) | $0.34\pm0.24^{c}$ | $0.62\pm0.01^{b}$ | $0.66\pm0.01^{ab}$ | $0.67\pm0.01^{a}$ | * |
| Egg shape index | 1.43±0.02 | 1.44±0.02 | 1.46±0.01 | 1.46±0.01 | NS |

a,b,c; Mean values in a row with different letter superscripts are significantly (p<0.05) different.
*= (P<0.05); NS= Not Significant.

**Table 4: Effect of body weight on the internal egg trait of shaver brown hens**

| Parameters | T1 | T2 | T3 | T4 | Sig |
|---|---|---|---|---|---|
| Albumin Height(mm) | 6.48±0.51$^{c}$ | 7.62±0.60$^{b}$ | 8.40±0.85$^{a}$ | 7.64±0.65$^{b}$ | * |
| Albumin Diameter(mm) | 10.24±0.01$^{C}$ | 10.30±0.02$^{b}$ | 10.35±0.01$^{ab}$ | 10.37±0.02$^{a}$ | * |
| Yolk Height(mm) | 17.52±0.39$^{b}$ | 18.96±0.22$^{a}$ | 18.73±0.20$^{a}$ | 18.40±0.16$^{a}$ | * |
| Yolk Diameter(mm) | 3.45±0.03 | 3.54±0.03 | 3.55±0.04 | 3.52±0.02 | NS |
| Yolk Index | 0.66±0.01 | 0.75±0.03 | 0.75±0.06 | 0.76±0.03 | NS |
| Albumin Index | 1.31±0.02 | 1.31±0.03 | 1.32±0.04 | 1.32±0.01 | NS |
| Egg Production, % | 76.35±3.21$^{a}$ | 73.69±0.86$^{ab}$ | 69.87±0.31$^{b}$ | 69.28±0.64$^{b}$ | * |
| Haugh unit, % | 75.52±0.29 | 75.0±0.41 | 75.5±0.65 | 76.5±0.65 | NS |
| Yolk Weight(g) | 16.14±0.14$^{b}$ | 16.49±0.24$^{ab}$ | 16.72±0.12$^{b}$ | 17.25±0.13$^{a}$ | * |
| Albumin Weight(g) | 36.23±0.74$^{c}$ | 38.10±0.93$^{b}$ | 38.88±1.02$^{a}$ | 38.98±0.67$^{a}$ | * |

a,b,c; Mean values in a row with different letter superscripts are significantly (p<0.05) different.
*= (P<0.05); NS= Not Significant.

## Results and Discussion

### Proximate composition of commercial diet used

Table 1 shows the proximate composition of the commercial diet used for the study.

### Effect of body weight on the performance of shaver brown hens:

Table 2 shows the effect of body weight on total egg production, hen day egg production and hen housed egg production. There were significant (P<0.05) effect in all the parameters except on initial body weight. T1 and T2 were statistically similar (p>0.05) but significantly (P<0.05) higher than T3 and T 4 in total egg production (TEP) values. T3 and T4 had smaller values of Hen day egg production (HDEP) than T1 and T2. T1 (76.35±3.21) was statistically higher in hen housed egg production than T3 and T 4. T4 had the highest feed intake among the treatment means while birds on T3 had the least feed consumption.

The higher values of total egg production recorded in T1 and T2 in this experiment agrees with (10) who reported that maximum egg production was recorded in the small weight category of Japanese quails and in poultry birds. This finding did not agree with (11; 12) who reported that Egg production of the heavy groups was higher than that of other groups (*P*< 0.05) in Partridges. Hen day egg production and hen housed egg production which is in line with what (13) indicated that heavy body weight birds are superior to the low body weight (LBW) birds in egg quality traits but not in egg production indices, T1 and T2(LBW categories) both were significantly (P<0.05) different from T3 and T4 in the total number of eggs produced, hen day egg production and housed egg production , this could be attributed to the fact that low body weight birds laid more eggs as reported by (14). Also (15) indicated that egg number is negatively correlated with egg size. The heavier the weight of the bird the lesser the number of eggs produced. (14) also observed that birds which produce fewer eggs tend to have bigger eggs than birds that produce many eggs.

**Table 5: Cost implication of different body weight on cost of egg production (N)**

| Parameters | T1 | T2 | T3 | T4 | Sig |
|---|---|---|---|---|---|
| Dozens of Egg Produced Per Bird | 4.31±0.63$^{a}$ | 4.34±0.49$^{a}$ | 4.10±0.22$^{b}$ | 4.06±0.41$^{b}$ | * |
| Price per Crate of Egg | 6.50±0.00 | 6.50±0.00 | 6.50±0.00 | 6.50±0.00 | NS |
| Feed Cost | 85.60±0.00 | 85.60±0.00 | 85.60±0.00 | 85.60±0.00 | NS |
| Total Feed Cost | 0.32±0.54 | 0.34±0.02 | 0.36±0.02 | 0.35±0.02 | NS |
| Cost of Feed Consumed | 37.93±13.42 | 29.15±1.81 | 31.65±0.17 | 29.67±1.86 | NS |
| Price Per Dozen of Egg | 2.60±0.00 | 2.60±0.00 | 2.60±0.00 | 2.60±0.00 | NS |
| Revenue from Dozens of Egg Produced | 1.12±16.3$^{a}$ | 1.13±12.76$^{a}$ | 1.06±5.85$^{b}$ | 1.05±9.65$^{b}$ | * |
| Gross Profit | 1.083±5.46$^{a}$ | 1.09±13.04$^{a}$ | 1.04±5.81$^{b}$ | 1.05±0.65$^{b}$ | * |

a,b,c; Mean values in a row with different letter superscripts are significantly ($p<0.05$) different.
*= ($P<0.05$); NS= Not Significant.

**Effect of body weight on the external egg trait of Shaver brown hens**

Table 3 shows that there were significant ($P<0.05$) differences in egg weight in all the treatment. T1 (61.89±0.62g) and T2 (63.22±0.64g) had the least egg weights, due to their light body weight; T1 had the least shell weight while T4 had the heaviest egg weight (64.65g). Egg Shell thickness of T1 was also least due to their body weight. T1 (0.34±0.24mm) was significantly ($P<0.05$) smaller in egg shell thickness than other groups.

The higher value of egg weight obtained in this study in T3 and T4 agreed with (16) that observed that Egg size had significant ($P\leq0.05$) effects on shell weight, shell thickness, and shape index. (16) also proposed that shell weight, shell thickness and shape index reduced with increasing the egg size. The Significant ($P<0.05$) differences that was observed in the egg shell thickness may be attributed to the differences size of the eggs produced. The non-significant differences observed in this finding disagree with (6) who reported that big eggs are supposed to have a higher shape index.

**Effect of body weight on the internal egg trait of Shaver brown hens**

The effect of body weight on the internal egg trait of shaver brown hens is shown in table 4.

The result showed that there were significant ($P<0.05$) differences in albumin height, albumin diameter, yolk height, % egg production, yolk weight and albumin weight. T1 had the least value of albumin height while T3 was statistically ($P<0.05$) higher than other treatment groups. The value of albumin diameter was statistically ($P<0.05$) higher in T4. The yolk height value of T1 was statistically lower than other treatments. T1 had higher value of %egg production than T3 and T4 but similar value with T2. The yolk weight of T4 was higher than others but similar to T2. Also, T1 had the lowest albumen weight compared to other groups.

From the result obtained, T4 had the highest performance in all the internal characteristics except in albumin height and % egg production. The non-significant differences observed in yolk index, albumen index and the Haugh unit supports the report of (17) which showed that yolk weight appeared to be very constant for any given hen.

The current finding contrast the report of (16) who reported that no significant (P≥0.05) effect on yolk weight, albumen weight, and yolk to albumen ratio at late laying stage of production period in broiler breeders. Feed nutrients and genetic factors could be the possible reason for this difference. Heavy eggs had a greater proportion of albumen and York weight than other groups. This agrees with the work of (16) that reported that Small eggs had a smaller proportion of yolk than Large and Medium eggs. These results agree with those of (18), who compared heavy and light eggs from 4 different strains. T2 showed some slight similarities between T3 and T4 in albumen height, albumen diameter, yolk height and yolk weight, Considering the values obtained, birds that had superior and more desirable internal qualities were birds that ate more as proposed by;( 19;20) during which minerals contained in the diet are deposited on eggs.

**Cost implication of different body weight on cost of egg production**

The result in table 5 showed that there were significant (P<0.05) differences in cost of dozens of eggs produced per bird, revenue from dozens of eggs produced and in gross profit. T1 and T2 had higher values of dozens of egg produced, revenue from egg and gross profit than T3 and T 4. The results agreed with (21) who reported that egg quality is the more important price contributing factor in table and hatching eggs. Therefore, the economic success of a laying flock solely depends on the total number of quality eggs produced (22).

**Conclusion and Applications**

The results of the study have shown

1. That the heavy body weight hens were superior to the light body weight hens in terms of egg quality but not on the egg yield obtained.
2. The light weight hens had the highest yield and less cost of feeding which is more profitable to farmers.
3. Therefore, rearing of pullets according to bodyweight groups is advantageous and could be practiced by poultry farmers in order to obtain improved performance of the flock and offer potential economic savings through more efficient production

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