COMPARATIVE EVALUATION OF REPRODUCTIVE AND EGG PRODUCTION PERFORMANCE OF TWO STRAINS OF LAYER CHICKEN RAISED IN THE HUMID TROPICS

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ABSTRACT
Various strains possess distinct genetic characteristics that influence egg yield and laying reliability. This *study was conducted to comparatively evaluate the egg production performance of Isa Brown layer and Nera black chicken strains at the teaching and research farm of Akwa Ibom State University. A total of 100 birds, 50 each of Isa Brown and Nera black chickens were used for the study. The parameters measured include feed intake, age at first egg, age at 5% lay, Age at peak lay, body weight at first egg and egg number on hen-day basis. The experimental design used was a completely randomized design composed of two treatments with five replicates of 10 birds per replicates for each treatment. Descriptive statistics was used to summarize all data obtained from the experiment. Data collected in the experiment was subjected to an independent T-test to compare means between the two strains. The results obtained for feed intake indicated that Nera black and Isa-Brown showed similar trends in feed intake; as the egg reaches its peak and started reducing, the feed intake decreased as well. The Nera black strain was more efficient in converting feed to egg, despite its higher feed consumption. Results on Reproductive performance revealed that the age at first egg lay for Isa brown and Nera black was 128.00 days (18 weeks) and 120.67 days (17 weeks) respectively. Nera black was the more efficient egg producer, laying its first egg earlier and reaching peak production later at 308 days (44 weeks) than Isa brown 280 days (40 weeks old). Results on egg production showed that Nera Black hens reached a peak production rate of 96%, outperforming Isa Brown hens, which achieved 91%. This suggests Nera Black's superior efficiency in egg production. As the hens aged, a slight decline in the production curve was observed, indicating a gradual decrease in egg output over time. It was therefore concluded that Nera Black hens demonstrated superior productivity and efficiency in egg production, outperforming Isa Brown hens in peak production rate and age at first egg lay making them a preferred choice for egg production in the study area.*
KEYWORDS*:* Reproduction, Egg production, Performance, Strains, Layer chicken

INTRODUCTION

The poultry industry has become a top agricultural sector globally in recent years. It is highly profitable (Sam *et al.,* 2024; Ebong *et al.,* 2023; Sam et al., 2023) and offers quick returns with low capital investment, making it a fast track to development (Ndak *et al*., 2022, Essien *et al* 2024; Usoro and Christopher, 2023). With its adaptability and short production cycles, the industry has experienced substantial growth (Essien and Sam, 2018; Essien *et al*., 2022; Usoro and Christopher, 2022; Ukpanah *et al*., 2022).

Layer chickens are essential to the poultry industry, providing eggs for human consumption (Onagbesan *et al.,* 2021). Poultry eggs provide essential high-quality animal protein (Sam, 2023; Ahmadi and Rahimi, 2021). With rising egg demand, producers must optimize production systems to meet market needs (Olawumi and Ogunlade, 2018; Dogara *et al.,* 2021). Choosing the appropriate layer strain is crucial (Ojedapo, 2023), as strains vary in egg yield, feed efficiency, disease resistance, and adaptability to climate (Khan *et al.,* 2024). Layer chickens are bred for high egg production, but genetic variations among strains affect egg quantity, size, and shell quality (Roushdy *et al.,* 2008). Age significantly influences egg output, with peak production typically occurring early in the laying cycle, followed by a gradual decline as hens age (Sam, 2023; Yasmeen *et al.,* 2008). Strains differ in laying persistence and the rate at which production declines with age. Considering age in layer egg production is crucial (Sam, 2023: Tumova *et al.,* 2017), as it significantly impacts productivity, and profitability.

The evaluation of egg production in two layer chicken strains, affected by age, involves analyzing differences in egg output and consistency across their laying cycles (Singh *et al.,* 2009). Different strains have unique genetic traits that impact egg yield and laying reliability. Identifying high-performing strains enables farmers to enhance egg production, improving farm efficiency and profitability (Folorunsho *et al.,* 2016). Choosing strains with sustained productivity reduces the need for frequent flock replacements, lowering costs and environmental impact. Certain strains perform better in specific environments, such as cage-free, free-range, or intensive systems (Ajiboye *et al.,* 2019). Egg production is strongly tied to feed efficiency, and strains with better feed-to-egg conversion ratios lower costs, which is crucial for large-scale operations (Tumova *et al.,* 2017).

Comparative studies pinpoint strains that optimize resource efficiency. Comparing egg production across strains provides stakeholders with valuable insights to boost economic returns, enhance animal welfare, and maintain a consistent egg supply (John-jaja *et al.,* 2016; Wondmeneh *et al., 2013)*. Assessing their performance helps farmers select strains that match their infrastructure, climate, or available resources, fostering sustainable practices. This study was conducted to evaluate reproductive and egg production performance of two strains (Isa Brown and Nera Black) of layer chicken in the humid tropics.

MATERIALS AND METHODS

Location of the Experiment

This study was carried out at the Poultry Unit of Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa. Obio Akpa is located between latitudes 4º30ºN and 5º00N and longitudes 70º30ºE and 80º00E. The area is characterized with an annual rainfall ranging from 3500 – 5000 mm and average monthly temperature of 24.50C during the wet season and 27.5 ºC during the wet season and relative humidity between 60 - 90%. It is in the tropical rainforest zone of Nigeria (AKSG, 2022).

Management of the Experimental Birds

A total of one hundred (100) chickens were raised in a battery cage and used for the experiment and consisting of fifty (50) birds in each of the strains: Nera black and Isa Brown. Each group of 50 birds was further divided into five replicates of 10 birds per replicate.

The birds were vaccinated against Marek, New castle disease (NCD), Gumboro, Fowl Typhoid, and Fowl Pox at the appropriate age as recommended by veterinarians. In addition, the Oxytetracycline plus (OTC plus) was given when necessary. Standard vaccination and medication were strictly adhered to and strict sanitary measures followed during the experimental period. Standard layer ration was fed with a diet purchased from local feed mill containing 17.9% CP, 2784.8 kcal/kg ME).

Collected and calculated data

Data was collected on the feed intake of the bird, age at first egg lay, weight of the first egg, body weight of the birds at first egg and hen-day egg number.

Age at first egg: This was taken on replicate basis, as the age at which the birds produced their first egg.

Body weight at first egg: The birds in each replicate were weighed at their first egg to obtain their body weight at first egg.

Weekly % lay = (weekly number of collected eggs per pen / actual number of hens present per pen) X 100;

Age at 5% Lay (days) = when the pen reaches 5% laying (Wondmeneh *et al*., 2015);

Egg production per hen-day = (No. of eggs per day / No. of live birds on the same day) X 100;

Average % lay at peak of lay = the maximal weekly % lay in each pen;

Age at peak of lay = the age of maximal weekly % lay in each pen;

Average number of eggs/hen/72wks = total number of eggs laid during 55 weeks (from week 17 to 72 weeks) / the average number of live hens during these 55weeks;

Experimental Design

The experimental design used was a completely randomized composed of two treatments with five replicates of 10 birds per replicate for each treatment, a total of 100 birds were used.

Statistical Analysis

Descriptive statistics was used to summarize all data obtained from the experiment. Data collected in the experiment was subjected to an independent T-test of SPSS (2021) version to compare means between the two strains. Data was presented in tables and graph. The statistical model used was Yij = ù+ Ti + eji. Where Yij = Individual observation, u = population mean, Ti = strain effect , eij = Error effect.

RESULTS AND DISCUSSION

Table 1 presents the cumulative mean value ± standard error(SE) of percent egg production of Isa brown and Nera black layer chicken from week 17-72. Results shows that the cumulative mean ± SE of Isa brown and Nera black were 71.63 + 4.89 and 80.45 + 4.42 respectively.

Table 1: Cumulative Mean value of %Hen Day Egg Production (WEEK 17 - 72)

STRAINS	Mean ± SE	Min Value	Max Value	SD
ISA BROWN	71.63 + 4.89	10.00	92.00	23.99
NERA BLACK	80.45 + 4.42	26.00	99.00	21.66

SE= Standard error, SD= Standard deviation

Table 2 shows the cumulative mean value ± standard error of Age (days) at first egg lay, Age(days) at 5% lay, Age (days) at peak lay, no of egg/bird/day and body weight at first lay of both strains. Results revealed that the mean ± SE value of Isa brown and Nera Black were 128.00 ± 1.15 and 120.67 ± 1.20 days at first lay, 149.00 ± 1.15 and 117.33 ± 0.88 days at 5% lay , 280.33 ± 1.83 and 308.00 ± 1.32 days at peak lay, 0.73±0.02 and 1.33±0.11 no of eggs/bird/day and 1.66±0.62 and 1.72±0.15 kg weight at first lay for Isa brown and Nera Black laying chicken respectively.

Table 2: Descriptive statistics of reproductive performance of ISA BROWN and NERA BLACK Chicken

Parameters	STRAIN	Mean ± SE	Min Value	Max Value	SD	CV
Age (Days) At First Egg Lay	Isa Brown	128.00±1.15	126.00	130.00	2.00	1.56
	Nera Black	120.67 ±1.20	119.00	123 .00	2.08	1.72
Age(Days) At 5% Lay	Isa	149.00±1.15	147.00	151.00	2.00	1.34
	Nera	117.33±0.88	116.00	119.00	1.52	1.30
Age (Days) At Peak Lay	Isa Brown	280.33± 1.83	260.00	301.00	20.50	0.89
	Nera Black	308.00±1.32	307.00	309.00	1.00	0.32
Number Of Egg/Bird/Day	Isa Brown	0.73±0.02	0.66	0.76	0.02	2.74
	Nera Black	1.33±0.11	1.20	1.42	0.03	2.26
Body Weight At First Lay(Kg)	Isa Brown	1.66±0.62	1.64	1.82	0.04	2.33
	Nera Black	1.72±0.15	1.52	1.74	0.01	0.61

SD = Standard deviation, CV= Coefficient of variation

Reproductive performance of Isa brown and Nera black layer chicken

Table 3 presents the reproductive performance of Isa Brown and Nera Black chickens, revealing significant differences ($p<0.05$) in all measured parameters. Nera Black chickens laid their first egg earlier at 120.67 days (17 weeks) compared to Isa Brown at 128.00 days (18 weeks). Nera Black also reached peak egg production later at 308 days (44 weeks) than Isa Brown at 280 days, (40 weeks), indicating greater egg-laying efficiency. These findings contrast with Wondmeneh *et al*. (2011), who reported average age of 147 days for first egg production, but align with Grobbelaar *et al.* (2010), who noted a similar sexual maturity age (128.5 days) in the Potchefstroom Koekoek breed. Nera Black's reproductive rates surpassed those reported by Izundu *et al.* (2019) and achieved the highest peak egg production percentage. Variations between this study and others may stem from differences in breed, nutrition, and three-dimensional space.

Table 3: Reproductive performance of ISA BROWN and NERA BLACK (WEEK 17 - 72)

Parameters	ISA BROWN	NERA BLACK	SEM	P- value
Age at first egg lay (days)	128.00 ± 1.15[a]	120.67 ± 1.20[b]	0.63	<0.0001
Age at 5% lay (days)	149.00 ± 1.15[a]	117.33 ± 0.88[b]	1.21	<0.0001
Age at peak lay (days)	280.00 ± 1.83[b]	308.00 ± 1.32[a]	1.64	<0.0001
Number of egg /bird/day	0.73 ± 0.00[b]	1.33 ± 0.01[a]	0.31	<0.0001
Body weight at first lay(kg)	1.60 ± 0.04[b]	1.72± 0.02[a]	0.01	<0.0001

Feed intake of Nera black and Isa brown layer chicken

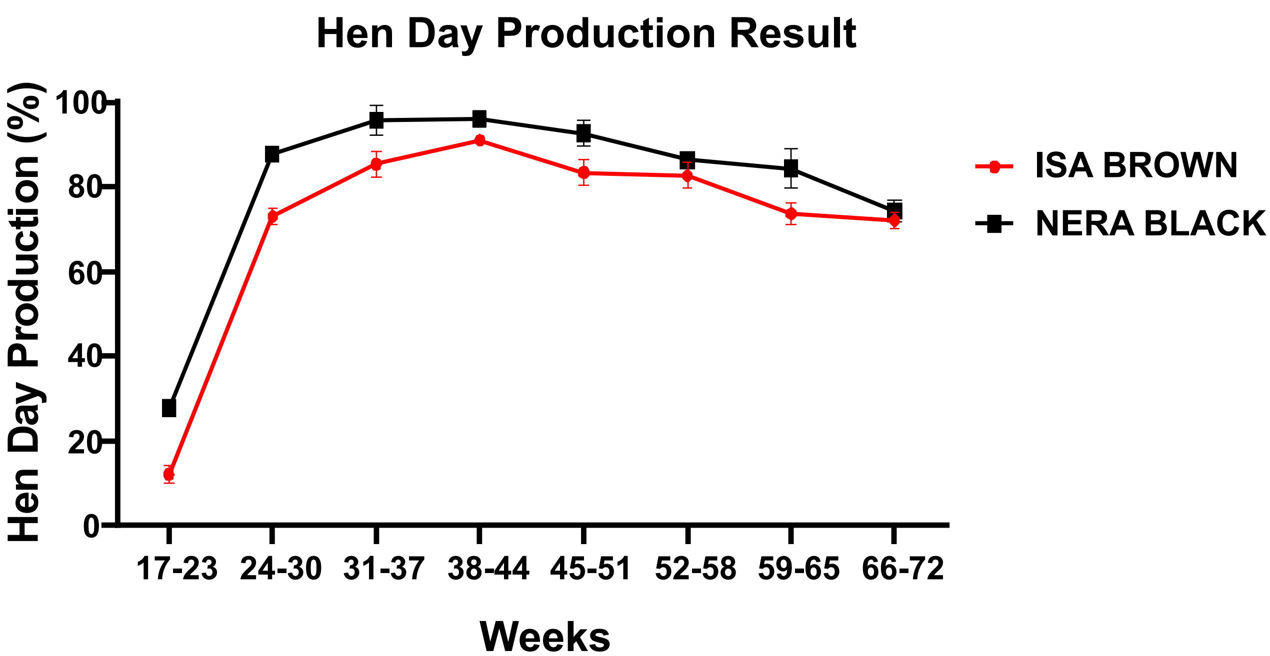
Table 4 displays the feed intake of Nera Black and Isa Brown layer chickens, showing significant differences between the two strains throughout the study. Nera Black consumed more feed over the 55-week period, influenced by genetic factors, as larger breeds tend to eat more due to their size. However, Hossain (1992) reported no notable difference in daily feed intake among Rhode Island Red, Barred Plymouth Rock, and indigenous DESI hens. Feed intake peaked between 38-44 weeks, declining as egg production decreased, with both strains exhibiting similar trends. Despite higher feed consumption, Nera Black was more efficient in converting feed to eggs, consistent with Singh *et al.* (2009). Both strains consumed less than the 123g/bird/day reported by Wondmeneh *et al.* (2011). While Rose (1997) suggests birds consume about 5% of their body weight in feed daily, Bamidele *et al.* (2020) argue that energy intake limits growth rate. Genetic makeup influences feed intake, and environmental factors, particularly temperature, accounted for 97.2% of intake variation, aligning with findings of reduced feed intake in high temperatures (Obayelu and Adeniyi, 2006; Talukder *et al.*, 2010).

Table 4: Effect of strain on the average feed intake (g/bird/week)

Weeks	ISA BROWN	NERA BLACK	SEM	P-Value
17 - 23	96.12 ± 2.30[b]	98.45 ± 2.11[a]	1.45	<0.0001
24 - 30	120.06 ± 1.80[b]	123.62 ± 2.13[a]	2.17	<0.0001
31 - 37	125.03 ± 1.40[b]	126.41 ± 2.60[a]	1.12	0.0386
38 - 44	126.06 ± 1.32[b]	127.11 ± 1.21[a]	1.12	0.0386
45 - 51	126.00 ± 0.12[b]	127.10 ± 1.14[a]	1.88	<0.0001
52 - 58	125.20 ± 0.62[b]	126.11 ± 0.11[a]	1.17	0.3280
59 -65	124.22 ± 1.45[b]	125.90 ± 1.01[a]	1.12	0.0386
66 - 72	123.52 ± 1.61[b]	124.14 ± 2.10[a]	1.14	0.0231

HEN DAY EGG PRODUCTION

Figure 1 illustrates the egg production performance of Isa Brown and Nera Black hens from weeks 17 to 72 during their laying phase. The graph, plotting % hen-day egg production (Y-axis) against time in weeks (X-axis), shows a typical egg-laying pattern with an initial sharp increase, reflecting the onset of laying as hens reach sexual maturity. Egg production rises rapidly from 12% to 73% for Isa Brown and 27.66% to 87.67% for Nera Black, peaking between weeks 38 to 44. Nera Black achieved the highest production at 96%, compared to Isa Brown 91%, indicating Nera Blacks' superior efficiency. The curve slightly decline after the peak, showing a gradual decrease in egg production as hens age affect output. This aligns with Ashraf *et al.* (2003), who noted strain differences, attributing Rhode Island Reds high output to genetics. Age significantly influenced production, with peak output at 38-44 weeks and the lowest at 17-23 weeks, consistent with Yasmeen *et al.* (2008), who linked higher production in younger hens to better feed efficiency. These results corroborate Hocking *et al*. (2003) and Yakubu *et al*. (2007), who reported genetic variations in egg production, but contrast with Hossein (1992), who found no significant strain effects. Reported production rates vary (57.0 - 63.7% by Wondmeneh *et al.,* 2011; 60.4% by Grobbelaar *et al.,* 2010), with discrepancies potentially due to genotype-environment interactions, as the strains development conditions may differ from the study testing environment.



CONCLUSION

It was concluded that Nera Black hens are more efficient egg producers, laying their first egg earlier and reaching peak production later than Isa Brown hens.

Despite higher feed consumption, Nera Black hens are more efficient in converting feed to eggs, highlighting genetic differences in feed utilization.

Egg production peaks and then declines with age, with Nera Black hens achieving a higher peak production rate of 96% compared to Isa Brown's 91%.

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